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IS NIPARS WORKING AS ADVERTISED? AN ANALYSIS OF NIPARS PROGRAM CUSTOMER SERVICE

THESIS

Peter F. de KAM, Captain, USAF
Dorothy J. Tribble, Captain, USAF

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Peter F. de KAM, B.A., M.S.
Captain, USAF

Dorothy J. Tribble, B.S.
Captain, USAF

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Preface

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Peter F. de KAM

Dorothy J. Tribble

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Abstract

The purpose of this study was to analyze whether or not the NIPARS program was performing as advertised. The idea for this research came about after discussions with SAF/IAPPW about possible areas for thesis work in Foreign Military Sales. An analysis of four factors (procurement administrative lead time [PALT], production leadtime [PLT], average time to cancel a requisition, and costs) were used to compare the performance of NIPARS to the performance of the previous method used to provide non-standard item support. The analysis of these factors rates the NIPARS program highly.

Additionally, a survey of the customers of NIPARS was conducted. This survey examined the expectations and perceptions of the customer service provided by NIPARS using the SERVQUAL (Service Quality) psychometric testing instrument. Extensive work was done to refine the SERVQUAL instrument to accurately reflect the views of customer service of the sample population. Because of the good results obtained with this instrument, it appears that, with some further refinement, it could be used as a standard measure of customer service within the DOD. This survey also looked at customers' views of whether the contractual measures of performance adequately measured the quality of service they receive. This was perhaps the most interesting area of analysis because it drove a comprehensive look at how the organization performed according to management indicators versus how customers expected it to perform as well as how well they thought it actually delivered service to the customer. In general, the service quality deliverd by NIPARS was rated higher than the service quality of commercial firms. However, further analysis showed that the contractual measures of performance had little influence on the customers' evaluation of service quality. This highlights the need for accurate measures of customer service as well as the difficulty of developing these measures.

IS NIPARS WORKING AS ADVERTISED? AN ANALYSIS OF NIPARS PROGRAM CUSTOMER SERVICE

I. Introduction

1.1 Overview

> Foreign policy must start with security. A nation's survival is at its first and ultimate responsibility; it cannot be compromised or put to risk. There can be no security for us or for others unless the strength of the free countries is in... balance with that of potential adversaries, and no stability in power relationships is conceivable without America's active participation in world affairs. (Kissinger, 1977: 197)

> Security Assistance is a fundamental component of U.S. defense and foreign policy. By contributing to a balanced country package of military and economic aid, Security Assistance encourages economic development and reform; contributes to base and facility access needed to bolster our own force projection capabilities; and promotes the interoperability of U.S. and Allied forces to strengthen our collective security framework. Security assistance is also our principle instrument for combating low intensity conflicts (LIC). ... Security Assistance plays a significant role in preserving our own security through collective efforts. — Former Secretary of Defense Frank C. Carlucci 18 February 1988. (DISAM, 1991: 1)

With the drawdown of its military forces, the United States has begun to rely more heavily on strategic alliances to project combat power when and where needed. This power projection is often accomplished by the strategic partner using U.S. supplied equipment. Therefore, the ability of the U.S. Air Force (USAF) to adequately support its Foreign Military Sales (FMS) customers directly impacts the national security of the United States and the foreign customer.

Foreign Military Sales is that portion of the United States security assistance authorized by the Arms Export Control Act, as amended, and conducted on the basis of formal contracts or agreements between the U.S. government and an authorized recipient, government, or international organization. FMS as defined for this thesis, includes government-to-government sales of defense articles or defense services from DOD stocks or through new procurement under DOD-managed contracts regardless of the source of financing (DISAM,1991: 546). It is big business with over $18.4 billion in sales in FY1990 (Grimmett, 1991:66). Customer service is a necessary condition for the successful execution of the political objectives of security assistance.

1.2 Background

> Providing and sustaining modern equipment to support a rapid expansion of the armed forces is...a difficult proposition. We will need a production base to produce new systems and a maintenance and repair base to support them. These requirements pose unique problems, as reduced defense budgets are shrinking the defense industrial sector overall. As we make procurements and investment decisions, we will have to place a value on the assured supply and timely delivery of defense materials... (The White House, 1991: 30)

1.2.1 Overview. Why is it important to evaluate the customer service of the Non-Standard Item Parts Acquisition and Repair System (NIPARS)? Along with the sale of a weapons system and its associated equipment, the long term support of these items is in the best interest of the United States Government (USG). Like its commercial sales corollary, "after market support," this long term (commonly referred to as follow-on) support is designed to keep equipment in operating condition. "Without (this) follow-on logistics support, a newly purchased weapons system rapidly takes on all of the characteristics of a museum piece—impressive, inert, impotent, and immobile" (DISAM,1991: 347). Another reason is that NIPARS represents an opportunity to reduce the military "tail to tooth" ratio, save money, and provide more responsive service to the units in the field. However, there is a third reason why it should be studied — it represents

an opportunity for the DOD to ensure the U.S. military industrial base retains its capability. The reader may well ask if this last statement doesn't represent a large intuitive leap. However, if the choice in these resource constrained times is between retaining the industrial capability/capacity of the USAF ALCs or retaining the industrial capability/capacity of the civilian sector, perhaps the more intelligent choice is to preserve the capability of the civilian sector. As a result, it is important to look at the actual performance (as well as the expectations and perceptions) of service delivery to the customer.

1.2.2 Logistics and FMS. As stated earlier, the long term support of a weapons system and its associated equipment is in the best interest of the United States Government (USG). Like its commercial sales corollary, "after market support", this long term (commonly referred to as follow-on) support is designed to keep equipment in operating condition. NIPARS was designed to efficiently and effectively provide "after market support" by reducing historically long lead times and put the DOD on a business footing to enhance FMS as an instrument of foreign policy.

Writing about his experiences with the logistics support of United States weapon systems and equipment in foreign nations, Brigadier General Boyd describes the massive size of some programs such as the ones in the Middle East. He also describes:

> others are small, involving only a few aging C-47s in South America. All, however, are important to the relationship between the United States and the 'customer' country. (The) use of the word customer is deliberate. These countries expect responsive service in terms of logistics support, technical help, and equipment delivery. (Boyd, 1990: viii)

The quality of service the FMS customer receives represents the output of the logistics function. It represents both the capability and the capacity of the NIPARS program. "It is a measure of the effectiveness of the logistics system in (providing) time and place utility for a product" (Stock and Lambert, 1987: 122). The process of assessing service quality begins

with understanding the customers' expectations as well as determining what differences exist between customer perceptions of the service provided and what the customer originally expected. The bottom line is that the customer, not the server, defines the quality of service. This suggests the traditional definition of quality for manufactured products (conformance to specifications) is quite inappropriate for assessing the quality of service delivery (Heskett, Sasser, and Hart,1990: 114). However, the utility provided to the customer as the result of the logistics functions of the organization is dependent on how customer service is operationalized within the organization.

Stock and Lambert (1987) state that the customer service construct can be operationalized in one of three ways: as an activity such as order processing, invoicing, or handling customer complaints; as performance measures, such as the ability to ship 95% of the orders received complete within 48 hours; or as an element in the total corporate philosophy, such as "Quality in number 1" (Stock and Lambert, 1989: 114). All of these indicate there is some desired level of performance in providing time and place utility for the customer which *can be measured*. Under NIPARS, cancellation rate and procurement administrative lead time (PALT) are the contractual measures used to define customer service and to gauge the contractor's effectiveness in providing non-standard item support. However, production lead time (PLT) and cost are just as important in an evaluation of the ability of a defense industry to provide the items and services required to build and sustain military forces during peace time and contingency operations. PLT provides a measure of the efficiency and effectiveness of the manufacturing entity. Cost provides a natural metric for the customer to evaluate the relative value of an item or service.

The cost aspect of services is becoming especially important as economic factors are changing the procurement practices of FMS customers. The rising cost of weapons designed and manufactured by the U.S. is forcing these customers to buy fewer newer models, thus creating more demand for non-standard items as weapon systems are phased

out of the active USAF inventory. "Customers are opting to upgrade what is already in inventory, or they are buying older equipment which has been modernized by an assortment of Third World and industrialized suppliers" (Neuman, 1990: 7). As a result, the international arms trade is comprised of a large number of suppliers offering a wider array of finished products and equipment to a more sophisticated and cautious pool of buyers. Neuman suggests "one consequence of these changes is the growth in supplier competition for sales and the creation of a buyer's market" (Neuman, 1990: 36). This shift is partly the result of a vigorous marketing campaign on the part of European sellers as well as "a reflection of the efforts of some FMS customers to reduce their military dependence on the U.S. or the Soviet Union by turning to European suppliers" (Snider, 1990: 37). By 1984 suppliers other than the U.S. and the Soviet Union had increased their market share from barely 2.5 percent in 1963 to almost 19 percent. These suppliers have continued to expand their markets (Figure 1). Specifically, Brazil, Singapore, South Korea, and Israel have contributed significantly to the creation of this buyers market by offering alternate sources of supply of certain types of weapons and logistical equipment (Neuman, 1990: 36). The arms sales market can be described as a zero sum situation; sellers can only gain market share at the detriment of the other competitors in the market. If the U.S. is to retain or even regain its market share, it must cope with this competition. The goal is to find a position where the U.S. can best defend itself against the competition: *a competitive advantage*.

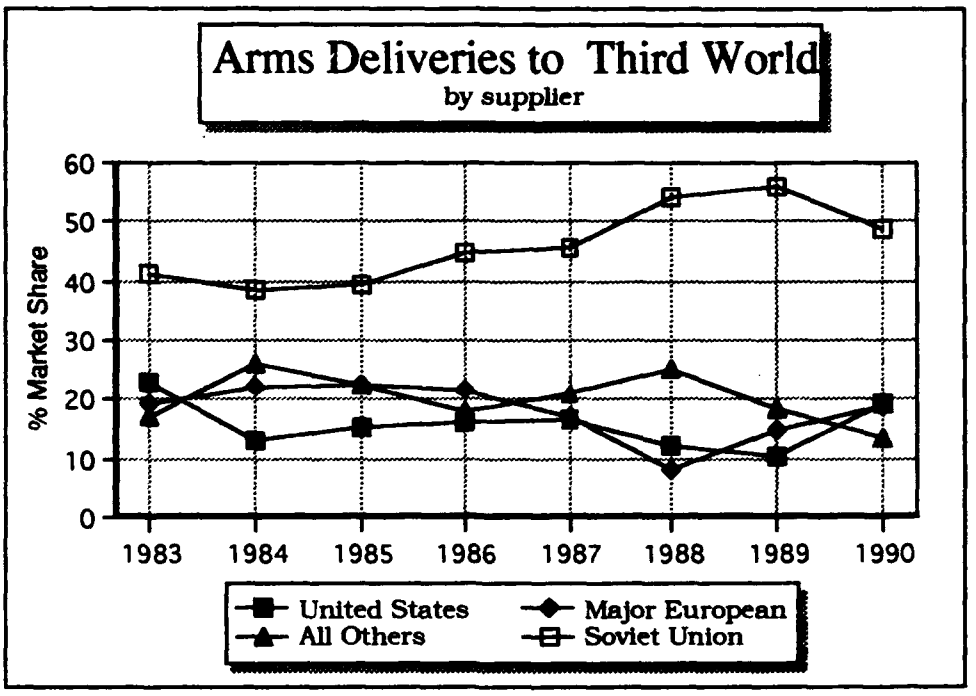


Figure 1. FMS Market Share (Grimmett, 1991:76)

Christopher has clearly stated: "logistics is the key to achieving and sustaining competitive advantage" (Christopher,1988: 21). He further explains that this advantage is attained through one of two ways: either through the reduction of costs or through providing superior values and benefits to the customer (Christopher,1988: 21-22). The business of the defense industry therefore must be customer service. It is getting the right part, to the right place, at the right time, for the right price, and in the right condition (Gecowitts, 1979: 11). Good customer service, in this case, means the United States as well as foreign governments can defend themselves adequately and affordably.

1.2.3 The Management of Business Operations. The ultimate driver in determining the quality of service delivered by an organization are the measures of performance that are used to control the management actions that ensure quality customer service. "Poor systems for controlling the delivery of service will not lead to organizational failure, nor will excellent management systems of control assure the organization's success" (Johnson and Kaplan, 1987: 261). Instead the organization's management control systems

must provide useful signals for the efficiency and effectiveness of the service delivery processes. If inadequate systems are used, the performance of the service delivery process cannot be captured. The particular management control system an organization uses is also the glue that binds the system together. It determines the manner in which the direction of an organization is established and coordinated as it moves through time toward some goal, mission, or objective (Figure 2). Novack describes a typical control system as "the implementation of a decision model and the use of feedback so that objectives are optimally obtained" (Novack, 1989:7). Rumelt believes a control system represents a set of "objectives, policies, and plans that, taken together, define the scope of (an organization) and its approach to survival and success" (Rumelt, 1991:53). Umble and Srikanth use a very simple definition: "(control is) making sure that all work centers perform the right tasks in the right sequence" (Umble and Srikanth, 1990:164).

1.2.4 Logistics and Competitive Advantage. While commercial firms have long recognized the necessity to drive down the amount of time it takes to provide goods or servi- they have only recently recognized that time represents the next competitive battle ground (Stalk, 1989: 41). Forester pioneered modeling this effect of time on organizational performance in 1958. His model of lead time within a small manufacturing pipeline (Figure 3) highlighted a simplified view of the movement of material through a system. However, this model is only stable as long as demand is constant and forecasts are accurate. Traditional production processes use lead time to resolve conflicts between the different sub-processes of the system. These resolutions create additional conflicts which invariably expand crowded schedules and lengthen the time required to deliver goods and services even further. The cumulative effects of this spiral of expansion are increased costs, delays, and system inefficiencies (Stalk, 1989: 45). Yet, environmental changes cause even more

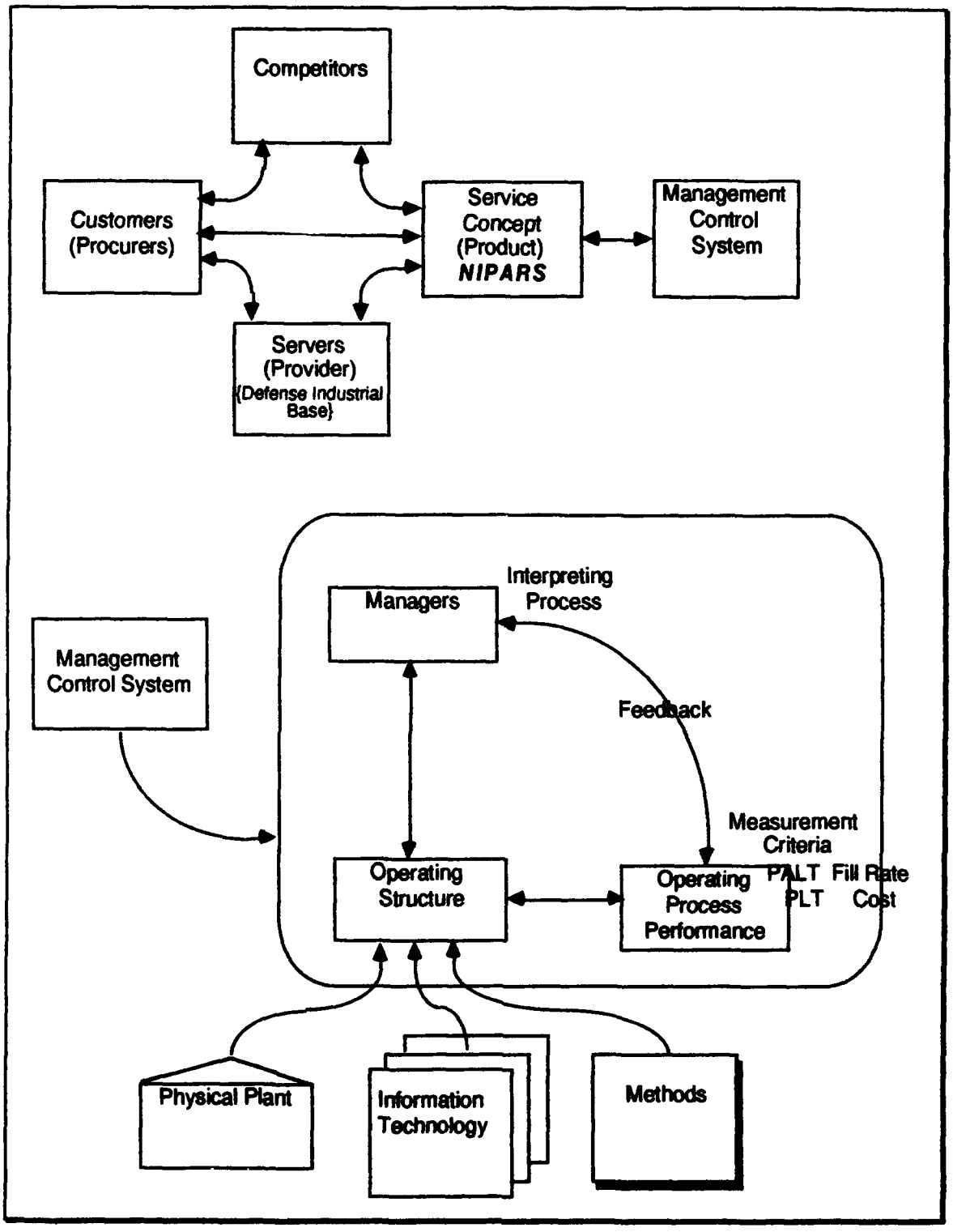


Figure 2. Customer Service Management Control System.

disruptions to the system. Production is disrupted resulting in waste and inefficiency as the system struggles to keep pace with changes.

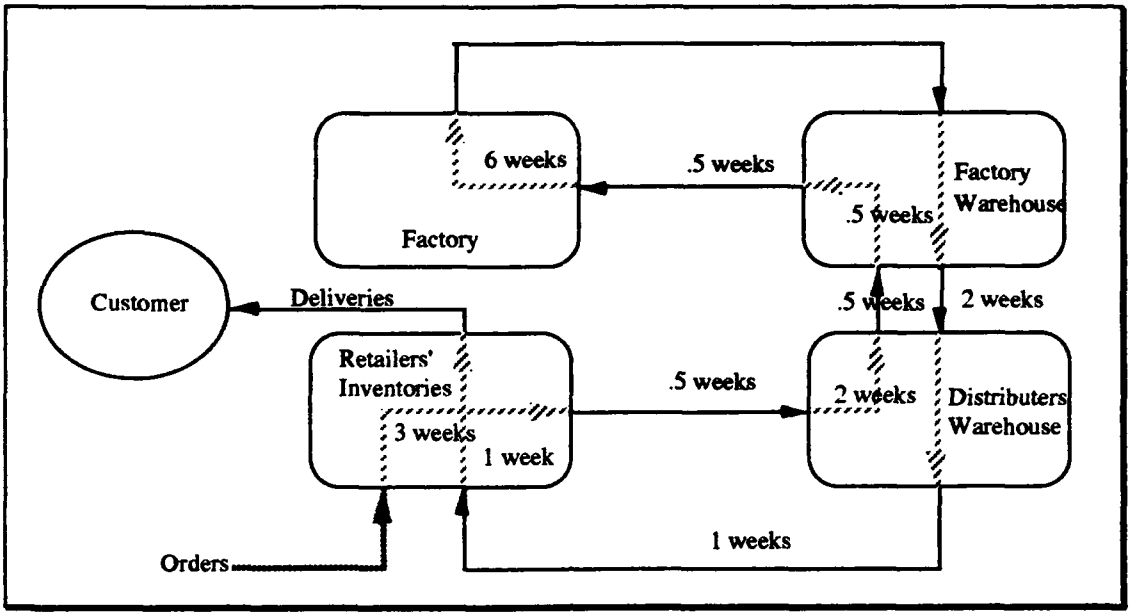


Figure 3. Lead Time (In Weeks) (Forrester, 1958: 41)

"The amount of corrective action and the time delays in interconnected systems can lead to unstable fluctuations" (Forester, 1958: 40). This is especially true in military procurement systems as a series of discrete components which, when interconnected, have unique characteristics that are independent of each component's own function. These interconnected systems can, like a living organism, assume a life of their own whose characteristics are the result of the time delays within the system components and the daily decisions of individuals within functions. These all combine to cause a distorted view of customer *demand* (what the customer really wants). This distortion of demand results in further difficulties in managing the procurement system efficiently and effectively when the system (prime contractors, subcontractors, vendors, and parts suppliers) must be surged to meet short notice requirements. Therefore, while the concept of time is being gradually introduced into commercial models of the movement of goods and services, it is imperative

that it must be inculcated into conceptions of the defense industrial base because after relatively short periods of preparation, future contingencies will be *"come as you are"* affairs.

"The traditional model used by defense planners (to balance requirements with industrial capability and capacity) is the D to P (D-day to Production) concept. This concept assures that at the early stages of a mobilization, demand will increase rapidly, and supply will eventually expand and build up at an increasing rate until the flow of new production balances with the requirements (of the forces engaged in their particular missions)" (Harold, 1992: 1). This mind set results in managers becoming stuck in a "planning loop" as they attempt to refine forecasts and increase lead times as well as safety stock. In other words, they treat the symptoms of the organizations' production process and never address the organization's structural problems. This approach prevents the organization from responding appropriately to environmental changes (Stalk, 1989: 46). Most importantly, as organizations symptomatically treat the problems which creep up in their productive processes, they lose sight of the real focus of the organization - creating time and place utility for their customer. In military procurement for aerospace forces, the result of not providing this utility to the customer is operational aircraft becoming expensive static displays. "Looking closely at a customer's needs, thinking deeply about a product - these are no exotic pieces of strategic apparatus. They are, as they have always been, the basis of good management" (Ohame, 1988 : 155).

1.2.5 Logistics and Customer Service. The pace of operations in modern warfare has increased dramatically. This dynamic environment can create requirements for items where no need previously existed and then, almost as quickly, requirements become obsolete as the next generation of item is deployed or the tide of battle has turned (Christopher,1988: 21-22). "There is no value in a product or service until it is in the hands of the customer or consumer" (Christopher,1988: 23). Customer service is therefore

dependent on time and place utility in the transfer of goods or services. James Davis (1974) and Sales Management magazine (1975) provide the most appropriate definitions of customer service as it relates to customer service for FMS customers. They describe it as "the sum of all interfaces between a company and its customers" and "those activities that enhance or facilitate the sale and use of one's products or services" respectively (Davis, 1974: 16; Sales Management, 1975: 1).

1.2.6 Customer Service, Logistics, NIPARS, and The Defense Industrial Base. There are several situations which affect the USG's ability to provide the level of service the customer desires. They arise because the USAF supply system is geared to providing items for aircraft which are currently in service and configured in a particular manner. However, if the weapon system in use by the customer has been modified for any reason before delivery or if the customer has modified some part of the system to meet particular mission profiles, then the customer often experiences problems obtaining adequate levels of support. Even greater problems are encountered when the weapon system is obsolete and hence no longer in the active inventory. In general, customer service is affected because the DOD no longer stocks, stores or issues these items; customer support is therefore lead-time away. More simply, the requisition must pass through the entire order cycle and manufacturing process, or perhaps even reverse engineering before the customer can receive the item. The net effect of this situation is increased lead time and higher cost for the customer. NIPARS was designed to reduce these lead times and provide positive supply support for all customer requirements and therefore enhance FMS as an instrument of foreign policy.

> Historically, the United States has been successful mobilizing industry to produce large quantities of material in support of the nation's defense. (However,) peak production has traditionally come about two years after the beginning of hostilities. In the decade of the 90's, the priority is to reduce the size of the defense budget and the standing forces. This makes the role of a strong defense base that much more critical. (Herold, 1992: 19)

The management of defense preparedness is therefore based on a policy of Graduated Mobilization Response (GMR) to future contingencies. The key to making GMR policy successful, and as a consequence provide the requisite quality and timeliness of customer service, will be to preserve the capacity of the parts suppliers and vendors that actually produce the items and support. The NIPARS program accomplishes this by regularly using parts suppliers and vendors to provide items. As a consequence, these companies are provided economic incentives to upgrade production facilities as well as keep the skilled labor essential for the production of these items instead of moving their operations into other areas or even to the extent of building off-shore facilities. As a result, the NIPARS program is an example of how the USG can enhance its competitiveness by reducing the cost of DOD operations as well as providing competitive customer service in the international market place.

1.3 Specific Problem

The research problem of this thesis is defined by the Secretary of the Air Force, Office of International and Political Military Affairs (SAF/IAPPW) as: Is NIPARS working as advertised? After preliminary discussions with this office, the problem was further defined as whether or not NIPARS has improved the process of acquiring non-standard items for the USAF FMS customer. Specifically, has the average time to cancel a requisition, PALT, PLT, and cost for the customer decreased due to the implementation of NIPARS, and are customers satisfied with the process?

1.4 Research Objectives

This study is based on the following objectives:

1. To compare the time to cancel, PALT, PLT, and costs for non-standard items acquired under NIPARS with those same performance metrics for previously existing procedures.

2. To review customer expectations and perceptions of the NIPARS process and its effect on the provision of non-standard items.

1.5 Hypotheses and Investigative Questions

1.5.1 Hypothesis One. A significant difference exists in the measures of performance for non-standard items under NIPARS versus the previous methods used to provide this support.

1.5.1.1 Investigative Question 1.1. Is there a significant difference between the average time to cancel a requisition for non-standard items under NIPARS versus the previous methods used to provide these items?

1.5.1.2 Investigative Question 1.2. Is there a significant difference between the PALT for non-standard items under NIPARS versus the previous methods used to provide this support?

1.5.1.3 Investigative Question 1.3. Is there a significant difference between the PLT for non-standard items under NIPARS versus the previous methods used to provide this support?

1.5.1.4 Investigative Question 1.4. Is there a significant difference between the PALT for non-standard items procured under NIPARS versus AF procurement of standard items?

1.5.1.5 Investigative Question 1.5. Is there a significant difference between the PLT for non–standard items procured under NIPARS versus the PLT for AF procurement of standard items?

1.5.2 Hypothesis Two. A significant difference exists in the costs of non–standard items under NIPARS versus costs under the previous methods used to provide this support.

1.5.2.1 Investigative Question 2.1. Is there a significant difference between the unit price for non–standard items under NIPARS versus the unit price for Air Force procured items?

1.5.2.2 Investigative Question 2.2. Is there a significant difference between the total costs for non–standard item support under NIPARS versus the total costs for Air Force procured non–standard items?

1.5.3 Hypothesis Three. The FMS customer views the NIPARS process as adequately meeting their requirements for non–standard items.

1.5.3.1 Investigative Question 3.1. Is the service quality (SERVQUAL) testing instrument a reliable and valid indicator of the sample population's expectations and perceptions of customer service?

1.5.3.2 Investigative Question 3.2. Do customers' perceptions of service exceed their expectations of service?

1.5.3.3 Investigative Question 3.3. Do customers view the contractual measures of performance as adequately measuring the quality of service they receive?

1.6 Scope and Limitations of Research

This investigation focuses on the provision of non–standard items to FMS customers. It is limited to USAF programs rather than other DOD programs such as the Navy Simplified

Acquisition (SIMPAC) program, the Army Nonstandard Acquisition Program (SNAP) contract, and the Defense Logistics Agency Contractor Operated Parts Depot (COPAD) program. It does not attempt to inquire whether the FMS customer was satisfied with previous programs designed to provide non-standard support, nor does it attempt to quantify the level of improvement NIPARS may represent. There is also no attempt made to forecast the impact of the AFLC/AFSC merger on the NIPARS program or any differences which may exist between ALCs. Additionally, the research does not consider the problems associated with the distribution channel to the FMS customer (freight forwarder to customer) nor does it consider the peculiar problems associated with contingency operations. The representative customer is defined as the AFSAC (Air Force Security Assistance Center) Country and Case Managers as well as the USG support personnel who are either actively involved in NIPARS program activities or have a working knowledge activities of NIPARS operations for their particular country.

1.7 Assumptions

This study assumes all data gathered from the various management information systems is accurate. It also assumes that all responses to questionnaires are truthful and that the personnel responding to the survey provide representative views of the NIPARS customer. Additional assumptions are listed in Chapter 3.

1.8 Organization of the Study

Chapter 2 expands the discussion of FMS and non-standard item support presented in Chapter 1 through an overview of the history of non-standard support. Chapter 3 contains a discussion of customer service as a product of a logistics system. Chapter 4 establishes the statistical and data sampling methodology required to analyze NIPARS operations. The findings from the investigative questions are presented in Chapter 5; and Chapter 6 presents the conclusions, summary, and recommendations for further study.

II. Background

2.1 Overview

This chapter discusses the evolution of non-standard item support from early support concepts to NIPARS implementation. It accomplishes this by reviewing and consolidating some of the historical documentation available on the subject.

2.2 Introduction

Despite the *Military Assistance and Sales Manual's* expressed preference to encourage commercial channels for support of non-standard items and systems, government-to-government methods have continued to increase as the most prevalent means of supporting U.S. supplied systems. This growing requirement to support deactivated weapons systems had increased from only a few in 1974 to 3,000 aircraft of 19 types in 1986. In addition, support of foreign configurations of aircraft still in the U.S. inventory (e.g., F-16 aircraft with non-U.S. avionics equipment installed) had swelled support requirements to over 51,600 USAF national stock numbers (NSNs) identified as used only by FMS countries. In 1986 alone, DOD management of these items was estimated to consume between 600 and 900 man-years of foreign military sales workload (Brusky, 1986).

An Air Staff study initiated in 1974 first identified the effect of this growth in non-standard support requirements as a serious problem. Although its basic purpose was to evaluate the impact of Security Assistance on Air Force activities, the Security Assistance Impact Study (SAIS) was the first major document to identify non-standard support as having significant repercussions to USAF resources (Picard and Phalen, 1977: 2). Its conclusions and the evolution of non-standard support policies were documented the 1977 thesis by Major James D. Picard and Captain Michael J. Phalen, *Non-standard Support*

Concepts in USAF Managed Security Assistance Programs, and later in 1985 by Captain Kathleen L. McLaughlin in her thesis, *Non-standard Support in USAF Managed Security Assistance Programs: Policies and Implications, 1977-1985*. Table 1 is included to assist the reader in tracking the evolution of non-standard support policies and programs.

TABLE 1.

HISTORY OF NON-STANDARD SUPPORT POLICIES AND PROGRAMS

Period	Concept	Major Theme
pre-1971	None	Non-standard support provided on an ad hoc basis
1971-1976	CONDEPOT	Contractor provided most non-standard support, to include warehousing in CONUS. Total package approach to support weapon system sale.
1976-1979	NISS	SA-ALC draft procedures (PACER GONDOLA) for contractor-provided non-standard support. Material storage in country. (Used only on Saudi programs) Aimed at total package support of all elements of ILS.
1979-present	CSIS	Contractor-supported program for RSAF. Increased contractor responsibility for non-standard item management. Continued total package approach.
1978-1990	NSIS	Series of Controlled Multiple Address Letters (CMALs) prescribing AFLC policy on non-standard support. Total package support addressed.
1990-present	NIPARS	Contract for non-standard support via prime contractor and vendors. Applicable to all countries and almost all FMS cases. Concentrates on follow-on logistics support with provisions for task orders to address other logistic support if required.

2.3 The 1977 Thesis (Picard and Phalen, 1977)

2.3.1 Introduction. This section will summarize the 1977 thesis by Picard and Phalen. All information is derived, verbatim or otherwise, from the above thesis with the

aim of providing a background for the reader to understand policy and procedural changes that occurred before and during 1977.

2.3.2 Overview. At the time of their thesis, non-standard support was provided to FMS customers on an ad hoc basis. Each case was considered unique and no standardized policy existed on the methods for provision of non-standard item support. While the Air Force policy for providing non-standard support was stated in (then) AFR 400-3 as "when directed by OSD, non-standard equipment may be purchased and follow-on support provided," no methodology for providing this support was outlined in any of the governing regulations or directives (Picard and Phalen, 1977: 4). It was into this climate that the Royal Saudi Air Force (RSAF) Peace Hawk program was born.

2.3.3 Peace Hawk Program. Dating back to 1971, the Peace Hawk program involved the sale of materiel and services, both standard and non-standard. The original Peace Hawk I case was established to purchase 20 F-5B aircraft and support equipment for Saudi Arabia in June 1971. Within 4 months, the Peace Hawk II case was set up for 30 F-5E aircraft and support equipment. Between these two cases, 6 systems containing approximately 300 non-standard items were involved. Concern over follow-on support of these items prompted a request for Chief of Staff, Air Force (CSAF), guidance on the long-term support policy. Concurrently, Saudi Arabia requested establishment of a third case, Peace Hawk III, that would require the USAF to enter a contract with the F-5 manufacturer to provide maintenance, training, and facility construction in support of the Peace Hawk I and II aircraft. The case was signed in mid-August 1972. In late August 1972, Air Staff acknowledged that follow-on support of non-standard items was not normal and would not continue indefinitely. The CSAF position was that support would continue only until the conclusion of the Peace Hawk III program in February 1976. In response to the request for follow-on non-standard support, a non-standard case was established in July 1973. Under this case, the USAF entered into a contract with Northrop Aircraft Division (NAD) to provide

a Contractor Operated Depot (CONDEPOT) for non-standard items which would function in the same manner as the AFLC-operated Depot Supply Support Program. Additionally, engineering and technical support were provided by NAD for engineering changes and country-peculiar technical manuals and data.

2.3.4 Material Support Under a Non-Standard Case. Material support under the CONDEPOT concept included having the contractor compute non-standard material requirements to cover in-country stock, pipeline, and CONDEPOT stock levels. After country approval of these levels, the contractor obtained and stored the material in a bonded warehouse within the Continental United States (CONUS). The country ordered supplies directly from CONDEPOT. Additionally, a list of items which could be repaired at CONDEPOT was developed and procedures were established for the country to ship the reparable items directly to CONDEPOT for repair and for their subsequent return to country. After beginning the operation of CONDEPOT, the contractor advised the USAF that significant cost savings could be achieved by using the standard USAF supply system to provide the contractor with standard repair parts used in the repair of non-standard equipment. Taking advantage of these cost-savings required allowing the contractor to requisition standard items through one of the other Saudi Arabia cases. The RSAF accepted the proposal and procedures were established in November 1973. The idea was to allow NAD to establish stock levels of the standard items required and requisition them from the DOD supply system. The DOD system would ship the items to the freight forwarder who would subsequently ship them to NAD. These stocklisted items would then belong to the RSAF and be available for country requisition from NAD.

2.3.5 Non-standard Proliferation. By 1974, the RSAF had requested an extension to the non-standard support agreement established earlier. In response, CSAF advised AFLC that "The Government of Saudi Arabia, at the highest levels, has requested the US Government to extend peculiar spares support provided under their non-standard

support case for an additional three years. The US Government has agreed to do so" (CSAF/LGFXR Letter, 1974: 1). Negotiations began concurrently for the Peace Hawk IV sale of 20 F-5Fs, 40 F-5Es, two simulators, an extensive aircraft improvement program, and support equipment. It also included the Peace Hawk V extension of the Peace Hawk III construction, maintenance and training case. The Peace Hawk V program which ran from February 1976 to February 1979 incorporated follow-on support of all 109 RSAF F-5s (including non-standard support).

2.3.6 Early Non-standard Support Policy Development. As stated earlier, the 1974 Security Assistance Impact Study (SAIS) identified non-standard support as a major problem area within Security Assistance agencies. As a result of this study, CSAF directed the Air Staff to resolve the issues identified, and AFLC began to hold a series of meetings dealing with non-standard support requirements. From these meetings, AFLC subsequently developed and presented the Air Staff with three possible non-standard support positions on 2 October 1975:

> 1. No AFLC involvement. Initial and follow-on support negotiated directly between the customer and the contractor (direct commercial sales).
>
> 2. Limited AFLC involvement with maximum reliance on the contractor to provide follow-on support.
>
> 3. Organic AFLC support for non-standard items. Many of the Grant Aid programs contained restrictions on use of monies for direct commercial sales which forced AFLC into this support concept. (Phalen & Picard, 1977: 21)

Of the three approaches to non-standard support, AFLC recommended that the Air Staff adopt the second concept for standardized procedures. AFLC envisioned using contractors to function as "mini-ALCs" to provide non-standard support and recommended that the Saudi Arabian Peace Hawk program be used as a pilot program to test implementation of this support concept. On 6 October 1975, Air Staff approved the test proposal, but withheld authority to use the concept in other non-standard cases until written procedures could be developed.

With negotiations in progress for the Peace Hawk V program which included non-standard support, some of the lessons learned with the CONDEPOT program were applied. In general, eight areas were defined as necessary to insure complete support of non-standard items, similar in nature to the concepts used in Logistics Support Analysis (LSA) and Integrated Logistics Support (ILS). The eight functions which require tailoring to each country's specific needs are:

1. Provisioning
2. Cataloging
3. Supply/Maintenance
4. Technical Orders (T.O.)
5. Materiel Deficiency Reporting
6. Configuration Control
7. Engineering Services
8. Requirements Computation

2.3.6.1 Provisioning. Provisioning is the process of determining the range and quantity of spares and repair parts required to support and maintain a system through its initial period of operations. It involves developing documentation to support decisions about the number and types of spares that will be required based on: estimated or actual failure data, time required to repair items, capability of the customer to perform repair, distance to source of repair, and funding levels available to purchase spares and repair parts. With standard items, the system or item manager normally performs this function. In FMS, the responsibility for this function can lie with either the system/item manager or the contractor.

2.3.6.2 Cataloging. The policies on the cataloging of non-standard items have undergone several changes over the years. Originally, non-standard items were not stocklisted which prevented their entry into the standard supply system. It became apparent, however, that cataloging of non-standard items offered benefits to both the customer and the USG. Cataloging of non-standard items reduces the amount of time spent researching item details for procurement, and allows collection of data about item

performance. In some cases, during screening of a non-standard item, a less expensive, stocklisted substitute part may be found. Regardless, cataloging is required for this screening process to take place. Either a U.S. government agency or a contractor may perform some of the actions required for cataloging non-standard items. Stocklisting (assigning a NSN) begins with comparing the item with Defense Logistics Services Center (DLSC) files to insure the item is non-standard. Once the item is determined as non-standard, data is subsequently submitted to DLSC for NSN assignment and user identification. Once this occurs, DLSC assigns a source of supply code and unit price, and the item is included in the Air Force cataloging records. This information is provided to the using country though the Stock Number User Directory (SNUD) and is also a means of interfacing with the International Logistics Program (ILP) Centralized Accounting and Reporting system for funding and reporting purposes (Picard and Phalen, 1977: 21-22).

2.3.6.3 Supply and Maintenance. Supply and maintenance includes storage, distribution, and repair of parts. It may include providing a stockpile of parts, developing requisitioning and routing procedures, providing order and shipment status, monitoring billing, and repairing and shipping parts. The elements used in establishing non-standard supply and maintenance depend largely on the capabilities of the customer's logistics system.

2.3.6.4 Technical Orders. Technical orders are crucial to effective support of non-standard systems. Although caution must be used to prevent non-standard information from entering the Air Force Technical Order System, each country requires specific instructions on the operation and maintenance of the equipment they own. As a result, non-standard data requires assignment of a manager to oversee these technical orders. Procedures must be established to manage the country-standard technical order program, identify writers and publishers, generate indexes, oversee validation and verification of country-standard procedures, develop methods for issuing and tracking of

Time Compliance Technical Orders, and establish procedures for correcting deficiencies in the country-standard T.O.s.

2.3.6.5 Material Deficiency Reporting. Just as standard items require a method for reporting material deficiencies, so do non–standard items. Areas that must be addressed are: the collection of data and data bank establishment, evaluation of reports, implementation of corrective action, and the assessment of the impact of interfacing non–standard and standard systems. Circumstances involved in the non–standard case often dictate where assignment of these responsibilities belongs.

2.3.6.6 Configuration Control. Configuration control becomes crucial when non–standard items are introduced into a system. Tasks such as tracking which item is installed on which system, and the engineering impact of the non–standard item on standard system performance are only two examples of configuration management responsibilities. The long-term advantage of possessing this data cannot be understated.

2.3.6.7 Engineering Support. Engineering support is unique in the arena of non–standard items. Often, the original manufacturer is the only one who has design data for the item, so plans must take into account what types of engineering services are needed; who will provide these services; and who will collect, maintain, and analyze the data to support these services. Logistics support must also consider the effect of engineering services on material deficiency reporting.

2.3.6.8 Requirements Computation. Requirements computation addresses the issues of who is going to be responsible for determining requirements for a foreign customer, what data will be used in the process, and who will maintain/collect that data and the equipment required to perform the requirements computation. With the U.S. goal of assisting countries in becoming self-sufficient, the ability of a country to determine its own requirements is a crucial factor (Picard and Phalen, 1977: 21-22).

2.4 The 1985 Thesis (McLaughlin, 1985)

2.4.1 Non-standard Item System Support (NISS). Capt McLaughlin points out in her thesis that the CONDEPOT program "covered over 1200 line items and 12 systems, and provided follow-on spares, configuration management and reporting, material deficiency reporting (MDR) actions, technical publications and data support, requisitioning and distribution, component repair and support, spares procurement, peculiar system ground support equipment replenishment, and most importantly warehousing." (McLaughlin,1985: 75) The pressure exerted by Air Staff led San Antonio Air Logistics Center (SA-ALC) to initiate a program code named PACER GONDOLA to develop a set of non-standard item system support (NISS) procedures. Although intended for application to all non-standard systems support, they were eventually used only in support of the Saudi programs. When the Peace Hawk III contract expired, its replacement program, Peace Hawk V, was implemented using the NISS concepts. McLaughlin highlights the CONDEPOT program's total coverage of engineering and provisioning services, while providing only partial coverage for configuration accounting, MDR, technical publications, and requisitioning/distribution services. Cataloging had not been adequately addressed until implementation of NISS (McLaughlin,1985: 44). Another significant change between the NISS concept and CONDEPOT was the elimination of the bonded warehouse in CONUS. During the transition, non-standard support increased to 15,000 items in 26 systems. In August 1977, the final NISS concept was implemented. In general, an item's coverage under NISS procedures was determined by the following criteria:

1. Not used on USAF aircraft
2. Possessed a part number
3. Required national stock number assignment
4. Not stocked by USAF depots
5. Operation and maintenance instructions not included in USAF T.O.s, and
6. Not repaired at a USAF depot. (McLaughlin,1985: 45)

2.4.2 Replacement of NISS with CSIS. "Although the NISS concept was working well, in January of 1979 the Country Standard Item Support (CSIS) concept replaced the NISS procedures" (McLaughlin,1985: 53). Its primary purpose was to include all of the NISS coverage, to pass more responsibility to the contractor, and increase the number of systems for which the contractor was responsible. Some of the areas changed under the CSIS concept were: item screening by Defense Supply Centers (DSCs), contractor spares storage, engineering services/MDR analysis, and protection of the USAF T.O. system from the introduction of country-standard data. Inclusion of item screening prior to stocklisting by the Defense Logistics Agency insured preferred/alternate items were not on hand in DSC's inventory. The authorization for the contractor to store spares in support of depot level repair/overhaul was also a change from the previous policy. Engineering services and MDR analysis changed to insure maintenance of data in support of MDR investigation was *not included* in the USAF deficiency reporting database. Additionally, the MDR responsibilities normally performed by SA-ALC were passed to the contractor for non-standard items. Another change was the requirement placed on the contractor to develop procedures insuring that technical data supplied in support of non-standard configurations was not entered into the USAF T.O. system.

McLaughlin quotes Colonel Markus K. Straume, then Deputy for Central Command Programs, in the rationale for continuing the CSIS program in 1984: "the ALCs have been unable to negotiate pre-established contracts on all subsystems (in support of the RSAF F-5s); and no evidence exists that support via (non-standard item support) procedures will be less expensive than support by Northrop" (McLaughlin,1985: 85).

2.4.3 Evolution of Non-standard Support Policy Guidance. Although the NISS procedures developed by SA-ALC were originally intended for application to all non-standard support cases, slippages in the completion of the PACER GONDOLA program caused AFLC to establish an AFLC Non-standard Support Study Group, which also became

known as the "ad hoc study group." McLaughlin states their purpose was "to determine how the USAF should evaluate each FMS request, and to determine the optimum approach to support non-standard configured systems" (McLaughlin,1985: 86). Included in the recommendations briefed to the AFLC Chief of Staff was an acceptable definition of a non-standard item, and the policy that the support concept for each non-standard configured system would be determined independently of the others. AFLC then took the lead in establishing a formal non-standard support policy. In January 1978, AFLC hosted an all-ALC conference. After being briefed to Air Staff, the recommendations generated by this conference became the procedures identified as Controlled Multiple Address Letter (CMAL) 78-5.

2.4.4 CMAL 78-5. Implementation of CMAL 78-5 instructions were not retroactive. The procedures advocated prearranged contractual support of non-standard systems by negotiating contracts with subsystem vendors and letting contracts for: spare parts procurements, depot level maintenance, T.O. verification and validation, and technical services. It required a separate FMs case for non-standard initial spares. Procedures would be similar to requesting a standard FMS case, however, the system manager would provide a recommendation to HQ AFLC stating the recommended method of support. AFLC would evaluate the recommendations and then develop the non-standard FMS case and forward the DD Form 1513, Price and Availability/Letter of Offer and Acceptance, to the customer.

2.4.5 Non-Standard Item Support (NSIS). "Between April 1978 and June 1979, CMAL 78-5 went through 5 revisions, and on 28 June 1979, it was finally published as CMAL 79-1" (McLaughlin, 1985: 67). This new policy became known as the Non-Standard Item Support (NSIS) Program. One effect of this policy letter was the increase in administrative surcharges on non-standard FMS cases from 3 to 5 percent. Although intended to cover AFLC's increased management costs for non-standard support, AFLC

anticipated customers' total cost would be reduced through reductions in material costs. While this CMAL was intended as interim operating guidance until its policies could be incorporated into the AFLC Supplement to AFR 400-3, it continued to be extended annually until 1985, and at the time McLaughlin's thesis was published, CMAL 79-1 remained in effect.

2.4.6 CMAL 82-1 and the Non-standard Support Study Group.

McLaughlin's thesis also discusses the proposed revision of CMAL 79-1 into CMAL 82-1, a document designed to specify the proposed revisions to governing regulations impacting non-standard support provision. It was never implemented. Instead, after reviewing the Non-standard Item Support (NSIS) program (CMAL 79-1) in May 1984, the then International Logistics Center (ILC) developed three initiatives. The first was the development of detailed part number requisitioning procedures and incorporation of those changes into AFR 67-1. Second, the Customer Generated Non-Standard Requisition Guide was to be published and distributed to all FMS countries. Third, the NSIS Study Group was to be formed to review the recommendations of all five ALCs. All of these actions were accomplished. The recommendations developed by the NSIS Study Group will be discussed in the next section.

2.4.7 NSIS Study Group Recommendations. McLaughlin's thesis discussed several projected changes to NSIS policy. The first recommendation, to change the term "non-standard" to "FMS nonstocked," was never implemented. However, the definition of non-standard was changed to "an item (with or without a National Stock Number) which the DOD does not actively manage for its own use" (Department of Defense, 1991: 1-20). The second recommendation, use of standard (rather than unique) Source of Supply codes for cataloging non-standard items, was implemented by incorporating changes into AFLC Regulation 72-2, *Cataloging and Standardization.* Additionally, the recommended changes to DOD 5105.38-M and AFR 400-3 (now AFR 130-1, *Security Assistance Management*)

have been made. The recommendations regarding changing the administrative surcharge to a requisition-by-requisition basis rather than forcing countries to establish non–standard cases were not accepted by the Security Assistance Accounting Center (SAAC). As a result, the policy of having the countries establish both standard and non–standard cases for follow-on support remained, and as a result, a 3 percent administrative charge was assessed for standard cases while non–standard cases were assessed a 5 percent charge. McLaughlin also cited two additional programs planned for implementation: The Consolidated Procurement Cycle, and Contractor Logistics Support for Out-of-Inventory Weapons Systems programs (McLaughlin,1985: 86). The Consolidated Procurement Cycle Program was designed to consolidate all FMS non–standard requisitions with low priorities (i.e., replenishment spares) for annual release to the source of supply. Its anticipated benefits included smoothing the flow of non–standard requisitions to the ALCs and enabling ALC personnel to generate purchase requests for larger quantities of items, thereby reducing unit cost to the customers. This program was never implemented as the NIPARS program eliminated the need for it.

The Contractor Logistics Support for Out-of-Inventory Weapons Systems Program became the precursor to today's Non–standard Item Parts Acquisition and Repair System (NIPARS). It was intended to affect items which were applicable

> solely to weapons systems no longer used by the DOD but which are provided to foreign governments through the USAF Security Assistance programs. This program would transfer system program management, inventory management, and procurement responsibilities from the ALCs to contractors. Support of 2500-3000 aircraft could be affected. (Boyd, 1985: 1)

McLaughlin also mentioned the creation of a tri-service team to study DOD support of non–standard items. The group was formed under the leadership of Lt Gen Phillip C. Gast, Director of the Defense Security Assistance Agency. The conclusion reached by the team was that due to the inherent differences between the types of weapons systems each service supplied and the differing internal organizations of each service, non–standard support was

best left to be tailored to the individual needs of the customers and the service providing that support. Today, each service performs its own non-standard support and contracted services (Brusky; 1992).

2.5 NIPARS

As stated earlier, one of the problems with non-standard support is the inherently labor intensive process of providing this support. The high manpower consumption required to administer non-standard requirements is the result of the difficult task of identifying part numbered items and their vendor, locating a current source of supply, developing purchase requests for small lot sizes, soliciting, negotiating, and subsequently administering the resultant numerous small contracts for delivery of these items. Often the same manpower that provides these services for FMS are the same resources that provide USAF support. When forced to compete for attention, the foreign customer's need is often subjugated to the higher-priority, active USAF requirements.

"Because of the problems associated with procuring non-standard parts, and the desire to improve support to their foreign customers, (AFSAC) initiated a program to streamline (AFMC) procedures for the procurement of non-standard items" (Brusky and Burton,1990: 87). In 1983, AFSAC prepared a Statement of Work for a feasibility study of deactivated weapons systems support. This study was designed to investigate the possibility of contracting out item management responsibility, as well as the contractor assumption of responsibility for System Program Management for these weapon systems. Various USAF and DOD organizations were solicited to perform this study; however, none accepted the tasking. In June 1984, AFSAC requested funding for a contractor to perform the feasibility study. By late August 1984, both the concept and funding were approved. In May of 1985, the contract to perform the study was awarded to MESA Corporation, Salt Lake City, Utah. The study's final report was submitted in May 1986, and included a draft Statement of

Work for the provision of contracted services for support of non-standard items. April through June 1986 were consumed with efforts to get "go-ahead" approval through Secretary of the Air Force level, and the remainder of the year was spent ironing out the financial aspects of turning the concept into reality. A Draft Statement of Work (SOW) was made available for contractor comments in September 1986. The comments necessitated a second draft of the SOW, released in December 1986, to address contractors' concerns. While further comments on the SOW were being reviewed at AFSAC, coordination of the Acquisition Plan through various levels to SAF/AQ was begun. Several complex legal and financial details delayed SAF/AQ approval until 28 April 1987. The next step was to develop and release the Request For Proposal (RFP).

As a contract awarded based primarily upon technical factors, the preparation and clarification of proposals, solicitation, and source selection proved to be a lengthy process. These efforts culminated on 14 September 1990, when the NIPARS contract was awarded to Systems Control Technology (SCT). This contract gave SCT overall responsibility for integration and management of non-standard items and parts acquisition (Brusky and Burton, 1991:80). The basic program concept moved the management tasks for non-standard items from USAF resources to SCT. Its primary objective was to "fix" the inefficiencies of the existing system for providing non-standard support. NIPARS was advertised as holding the potential not only to reduce workload in the face of shrinking FMS administrative budgets, but to take advantage of the inherent differences between commercial buying practices and those used for government procurement. Examining these differences, Capt Patricia Norman's thesis compared government procurement models (where the solicitation for bids or proposals and negotiation is conducted prior to evaluation and contract award) to commercial models (where vendors are selected before the order is placed) (Norman, 1991:21). As Perry demonstrates in his article, *Procurement Lead Time: The Forgotten Factor*, this difference means a significant reduction in lead time, and that

lead time reduction translates into improved system responsiveness, forecast accuracy, and reductions in inventory (Perry, 1990:16, 23). These reductions in lead time represent improvements to the level of customer service for our foreign customers.

Since the NIPARS contract was advertised as a means of improving customer service through lead time reduction, it is useful to examine the methods used by NIPARS to achieve these improvements. The requisitioning portion of the contract uses three primary measures to insure improved customer service: cancellation rate, procurement administrative lead time (PALT), and reduction in validated Reports of Discrepancy (RODs). Cancellation rate is the percentage of requisitions filled when compared to the total number received. PALT, for purposes of evaluating contractor performance, is defined as the time between contractor receipt of the requisition and the date the item is placed on contract (Brusky and Burton, 1990:81). Evaluation of the contractor's ROD performance is beyond the scope of this thesis and will not be addressed.

To administer its duties as the Air Force procurer of non-standard parts, Systems Control Technology (SCT) Inc., of Palo Alto, California functions as the prime contractor. They established a Support Services Division in Fairborn, Ohio, as the main operating location for the NIPARS program. This division leads a team of 5 subcontractors who provide the services required under the contract. Peterson Builders Inc. (PBI), of Sturgeon Bay, Wisconsin, and Charles V. Clark (CVC) Inc., of Dayton, Ohio perform the primary function of item research and identification, supply source location, and purchasing. KRUG International Corporation of Dayton, Ohio, supplies engineering services including reverse engineering, drafting and documentation support. Quality assurance and policy oversight is provided by Bahan Dennis Inc. (BDI), also of Dayton, Ohio. Additional support, such as interfacing with ALCs, is provided by United International Group (UIG) of Salt Lake City, Utah (Brusky and Burton, 1990:82).

A simplified explanation of the contractor's system (See Figure 4) is that the contractor receives requisitions from AFSAC (electronically transmitted), researches and identifies the required item, locates a source of supply, processes a purchase order to that source of supply, receives/inspects/packages the part, and delivers the item to the freight forwarder to be shipped into country. Additionally, the contractor must electronically update status of the requisition in SAMIS (Security Assistance Management Information System). The contractor subsequently pays the vendor and invoices the 2750 Air Base Wing, Wright-Patterson Air Force Base Accounting and Finance, Comptroller (2750 ABW/AC) for reimbursement (Brusky and Burton, 1990:83). Figure 4 depicts the flow of information and funds, while a simplified diagram of the pre-NIPARS non-standard FMS requisition flow is shown as Figure 5 for comparison purposes.

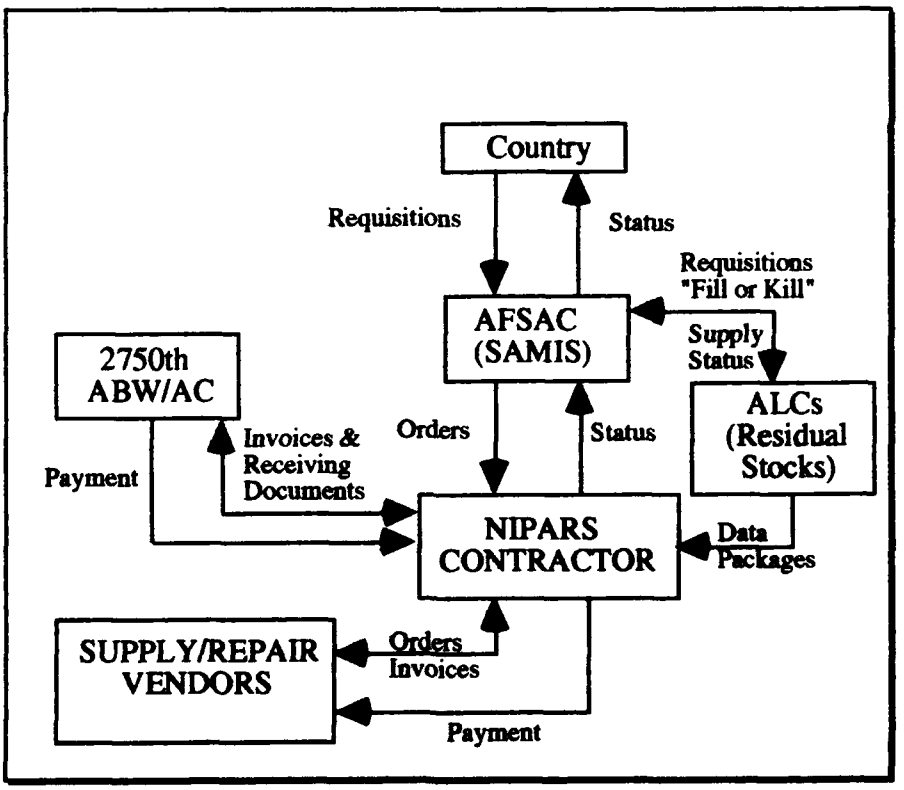


Figure 4. NIPARS Information and Funding Flow
(Brusky and Burton, 1990:84)

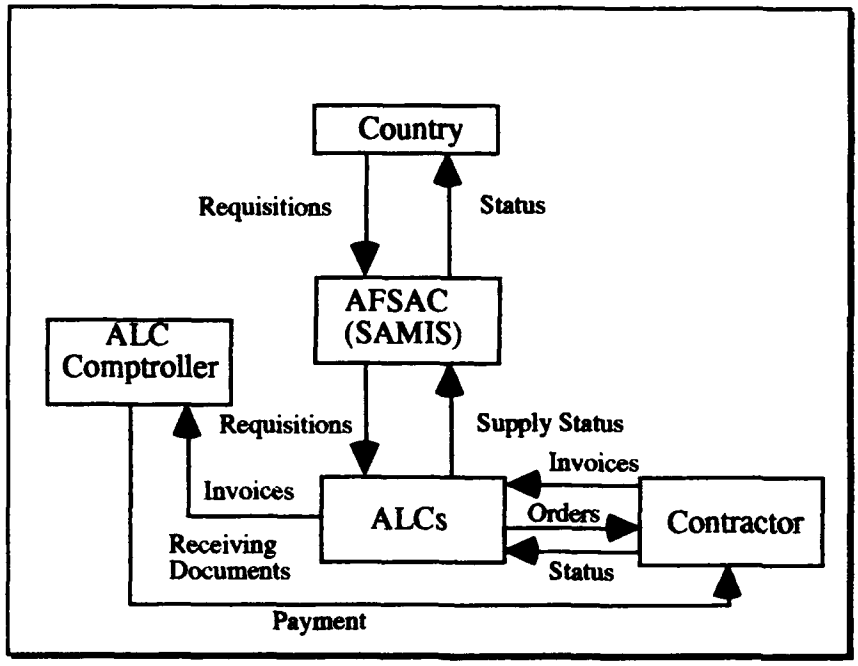


Figure 5. Pre-NIPARS Requisition Flow

The use of NIPARS is designed to be transparent to the FMS customer. As can be seen, the customer country submits requisitions to SAMIS as usual (see Figure 5); however, the similarity to the old system ends there. When SAMIS receives a non-standard requisition, it electronically passes the requisition to the ALC that has historically been responsible for procuring the item. However, unlike the previous method, the requisition is passed in "Fill or Kill" status. This means that if the ALC has residual stocks of the item on-hand, the requisition will be filled. The purpose of this stage is to insure that the contractor is not given responsibility for acquiring material that is already on-hand, and once depletion of these stocks has occurred, management responsibility for the item may be permanently passed to the contractor. To accomplish this management transfer, ALCs are required to transfer all necessary procurement data to the NIPARS contractor.

If the fill or kill requisition arrives and no stock exists, the requisition will be "killed" and SAMIS will receive notification. When the killed requisition notice is received in SAMIS, an

electronic interface to the 2750 ABW/AC checks for sufficient funds to cover both the estimated material costs and potential cancellation costs before the requisition is passed to NIPARS. The 2750 ABW/AC requests this amount of obligation authority (OA) from the Security Assistance Accounting Center (SAAC), and upon receipt of OA approval, reports funds approval to SAMIS. Following this approval, SAMIS notifies the customer with a "BU" or "BW" status transaction that indicates to the customer that the requisition has been passed to NIPARS. These events normally consume approximately three working days (Brusky and Burton, 1990: 90).

The NIPARS contractor then begins the task of item and source identification. When the order is received by NIPARS, the contractor acknowledges receipt to SAMIS by sending the appropriate status code. Once SAMIS receives this code, the contractor's PALT clock is "turned on." When the contractor identifies the source, he submits a price quote status transaction ("PQ") to SAMIS. This price quote includes the vendor's price for material and the SCT fee for filling the requisition. The SCT fees for filling requisitions are listed in Table 2. SAMIS checks internal records for sufficient funds to cover the requisition, and if necessary notifies the AFSAC Country/Case Manager that funds are not available. The AFSAC Country/Case Manager then has the option of canceling the requisition or obtaining the necessary funding. If, however, sufficient funds exist, or the country manager obtains the necessary funding, SAMIS updates the requisition value and requests additional OA through 2750 ABW/AC from SAAC. The approved funds notification to SAMIS generates an "OK" status transaction from SAMIS to SCT that authorizes the contractor to subcontract for the item. Once the contractor issues a purchase order to the supply vendor, he sends a MILSTRIP (Military Standard Requisitioning and Issue Procedures) transaction updating the requisition status code to "BV" to SAMIS. This turns the PALT clock off (Brusky and Burton, 1990: 83,90).

TABLE 2.

SCT FEE SCHEDULE FOR FILLED REQUISITIONS

NIPARS Contractor Fixed Price for Services (Two Year Basic Contract Period)		
Requisition Sequence Number*	Requisition Value	
	$0 - $2,500	$2,500.01 -$100,000
1 - 10,000	$108.80	$332.40
10,001 - 20,000	$102.86	$314.38
20,001 - 30,000	$99.40	$303.54
30,001 - 40,000	$98.27	$299.12
40,001 - 50,000	$81.50	$171.16
50,001 -Completion	$76.68	$129.04
NIPARS Contractor Fixed Prices for Services		
Option Year	Requisition Value	
	$0 - $2,500	$2,500.01 - $100,000
1	$89.36	$222.07
2	$92.12	$229.98
3	$95.00	$238.21
* Requisition sequence number applies to the chronological order by entry into the SAMIS system.		

As stated earlier, the contractor issues a purchase order to the supply vendor who produces the part, ships it to SCT, and invoices SCT for payment. SCT receives; visually inspects for kind, condition, and count; packages the part for shipment to the freight forwarder; and pays the vendor's invoice. SCT then updates SAMIS with an "AS_" shipping transaction and sends the paid invoice and the documents showing he received the part to 2750 ABW/AC for his payment (Brusky and Burton, 1990: 83,90).

While designed to be user-transparent, the costs associated with NIPARS are not like those used in previous methods. NIPARS offers customers the benefit of not having to establish non-standard cases for non-standard item support. As a result, the administrative surcharge for non-standard support is reduced to 3 percent from the 5 percent associated with non-standard support cases. Additionally, "below-the-line" charges for a separate FMS case are saved, and "rather than paying a percentage of material value

for material handling (which can typically range anywhere from 30 to over 100 percent per order), the customer will pay a fixed price per requisition for the contractor's services" (see Table 2) (Brusky and Burton, 1990: 87). In addition, if the contractor's performance warrants, a quarterly award fee can be earned by SCT. This award fee is funded under a special account that generates monies by billing customers a predetermined amount, based upon the value of the requisition. Table 3 shows the maximum award fees billed to a customer for a requisition. Since the amount of monies available in the special account will depend on the customer countries requisition activity in the previous quarter, the contractor's award fee is based on a percentage of what is available, or a maximum of $250,000 each calendar quarter. If the dollar amount held in the special account exceeds the amount needed for award fees, the amount billed to the customer may be adjusted downward or suspended entirely. "This insures that only the amount needed to replenish the account is collected" (Brusky and Burton, 1990:89).

TABLE 3.

CONTRACTOR AWARD FEE SCHEDULE (Brusky and Burton, 1990: 89)

NIPARS Award Fee Schedule	
Requisition Value	Award Fee Amount
0.00 - 100.00	0.00
100.01 - 500.00	10.00
500.01 - 2,500.00	50.00
2,500.01 - 10,000.00	200.00
10,000.01 - 25,000.00	500.00
25,000.01 - 50,000.00	1,000.00
50,000.01 - 100,000.00	2,000.00
100,000.01 and GREATER	4,000.00

One potential cause for concern by the customers of NIPARS is that they have greater visibility over price increases for non-standard items. Since submission of a requisition is considered legal authorization to purchase an item, it also indicates an agreement to accept

the costs associated with that purchase. Obviously, the customer wants to be notified if a significant increase in the estimated price occurs. One method NIPARS uses to combat this problem is the requirement placed on the contractor to obtain customer concurrence if a price quote meets the following criteria:

> a. The current quote for the item is between $2,500 -$10,000 and unit price exceeds 25% of the last procurement unit price adjusted to reflect current year dollars.
>
> b. The current quote for the item is over $10,000 and the unit price exceeds 10% of the last procurement unit price adjusted to reflect current year dollars.
>
> c. The current quote for the item is over $1,000 and the unit price exceeds 50% of the last procurement unit price adjusted to reflect current year dollars." (Brusky and Burton, 1990, 91)

Unfortunately, the customer country is often dependent on USAF catalog prices for their estimated costs. By their very nature, however, non-standard items are subject to large cost increases. This is often due to start-up costs, retooling, or reverse engineering needed to produce the item. This problem is exacerbated when an item hasn't been bought for several years and the catalog prices are therefore outdated. Often, when prices quoted are (on average) 85 percent higher than the catalog price, the customer may suffer from "sticker shock" when the SCT price quote is received. If the customer non-concurs with the price quote, he may cancel the requisition; however, a cancellation fee (See Table 4) is associated with this action. This fee is designed to compensate the contractor for the time and effort spent identifying the item, locating sources, and obtaining price quotes (Brusky and Burton, 1990:91).

TABLE 4.

SCT FEE SCHEDULE FOR CANCELED REQUISITIONS

NIPARS Contractor Cancellation Fees		
Requisition Sequence Number*	Requisition Value	
	$0 - $2,500	$2,500.01 -$100,000
1 - 10,000	$100.68	$161.05
10,001 - 20,000	$88.45	$148.77
20,001 - 30,000	$84.65	$146.13
30,001 - 40,000	$82.56	$143.19
40,001 - 50,000	$55.80	$86.56
50,001 -Completion	$48.38	$69.19
NIPARS Contractor Cancellation Fees		
Option Year	Requisition Value	
	$0 - $2,500	$2,500.01 - $100,000
1	$67.96	$108.03
2	$70.30	$112.14

* Requisition sequence number applies to the chronological order of entry into the SAMIS system.

In no case shall the fixed price payable be greater than the amount payable to fill the requisition.

Another fee associated with the NIPARS contract was designed to reimburse SCT for part number research efforts and preclude customer abuse of NIPARS as a stock number research center. The part number research fee is assessed for any part number which SCT successfully cross-references to a good NSN. Table 5 outlines this fee schedule. The reader must understand that this fee is only assessed when item research yields a stock number that will be supplied through standard FMS supply channels. It is not assessed in addition to a cancellation fee, or the basic service fee for NIPARS filling the requisition.

TABLE 5.

SCT FEE SCHEDULE FOR PART NUMBER RESEARCH

NIPARS Contractor Part Number Research Fees	
Requisition Sequence Number*	Fee
1 - 10,000	$21.34
10,001 - 20,000	$20.47
20,001 - 30,000	$20.36
30,001 - 40,000	$19.83
40,001 - 50,000	$16.34
50,001 - Completion	$15.32
NIPARS Contractor Part Number Research Fees	
Option Year	Fee
1	$18.06
2	$18.61
* Requisition sequence number applies to the chronological order of entry into the SAMIS system.	

This multitude of fees has created sizable concern over the cost of using NIPARS. Customers have expressed dissatisfaction over the service fee and cancellation fees when compared to material value. For example, a $5 part ordered in the 20,001 to 30,000 requisition sequence period would cost the customer $5 for the part and $99.40 in service fee (no award fee is assessed at this material value) for a total of $104.40. The service fees, cancellation fee, and part number research fee were negotiated as a firm fixed price between SCT and the USG. As such, they are not negotiable without opening the entire contract to renegotiation. The amount collected from the customer countries for award fees, on the other hand, can be varied according to the amount of monies needed. These customer concerns highlight the importance of examining more than just the traditional measures of contractor performance when assessing the quality of any delivered service. While PALT, PLT, and cancellation rates may provide satisfactory objective measures of performance to be used when determining monetary rewards, evaluating the quality of a service in terms of the customer's perspective requires more subjective measures.

2.6 *Summary*

This chapter discussed the evolution of non-standard item support from the CONDEPOT concept to NIPARS implementation. It accomplished this by reviewing and consolidating some of the historical documentation available on the subject. The next chapter examines both the standard measures used to evaluate the customer service of a logistics system, as well as the concept of customer service itself as a product of a logistics system.

III. Literature Review

> ...Through security assistance, the United States can demonstrate commitment, reinforce alliance cohesion, build upon bilateral relations, and provide a moderating influence vital to regional stability and cooperation. The use of US equipment, training, and professional military education can increase U.S. influence, foster interoperability, and build relationships which create the sympathetic global infrastructure crucial to effective crisis response. (Powell, 1992: 14)

3.1 Overview

Along with the sale of a weapons system and its associated equipment, the long term support of these items is in the best interest of the United States Government (USG). Like its commercial sales corollary, "after market support," this long term (commonly referred to as follow–on) support is designed to keep equipment in operating condition. As noted earlier; without follow–on support, weapons systems rapidly takes on all the traits of a static display. NIPARS was designed to efficiently and effectively provide this aftermarket support by reducing historically long lead times and put the USG on a business footing to enhance FMS as an instrument of foreign policy.

3.2 Background

The quality of service the FMS customer receives represents the output of the logistics function of the NIPARS program. "It is a measure of the effectiveness of the logistics system in (providing) time and place utility for a product" (Stock and Lambert, 1987: 122). However, the utility provided to the customer as the result of the logistics functions of the organization is dependent upon how customer service is operationalized within the organization.

Stock and Lambert (1987) state that the customer service construct can be operationalized in one of three ways: as an activity such as order processing, invoicing, or

handling customer complaints; as performance measures, such as the ability to ship 95% of the orders received complete within 48 hours; or as an element in the total corporate philosophy (Stock and Lambert, 1987: 113). This indicates there is some desired level of performance in providing time and place utility for the customer which *can be measured*. In the case of FMS, the definition of quality takes the form of event-related measurements of system performance, such as lead time, cancellation rate, and cost.

3.3 Measures of Events Affecting Customer Service

3.3.1 Lead Time. One of the traditional event-related measures of system performance is lead time. Cook suggests a simple definition of lead time as: "the time required to acquire material" (Cook, 1990:16). Stalk conceptualizes this definition as the result of traditional management processes which require "lead time to resolve conflicts between various jobs or activities that require the same resources" (Stalk, 1989: 46). These resolutions create additional conflicts which invariably lengthen the time required to deliver goods and services even further. The cumulative effect of this spiral of expansion are increased costs, delays, and system inefficiencies (Stalk, 1989: 45). As a result, lead time is one of the most significant factors affecting customer service.

Depending upon the focus, this lead time can be broken down into several generic segments (See Figure 6). The beginning and ending points used for measuring lead time vary within the DOD as well as in the civilian sector. However, it generally starts with the generation of an order and ends with the delivery of the item. In his article, *Procurement Lead Time: The Forgotten Factor*, Dr. James H. Perry breaks procurement lead time into two categories: administrative and production (Perry, 1990: 17). For purposes of this thesis, the first segment, PALT (procurement administrative lead time), is defined as the date of order receipt to the date of contract award. The second segment, PLT (production

lead time), extends from contract award to shipment of the item to the customer. Clearly, PALT and PLT, as the front end of the service delivery process, are important elements of a customer's evaluation of service quality.

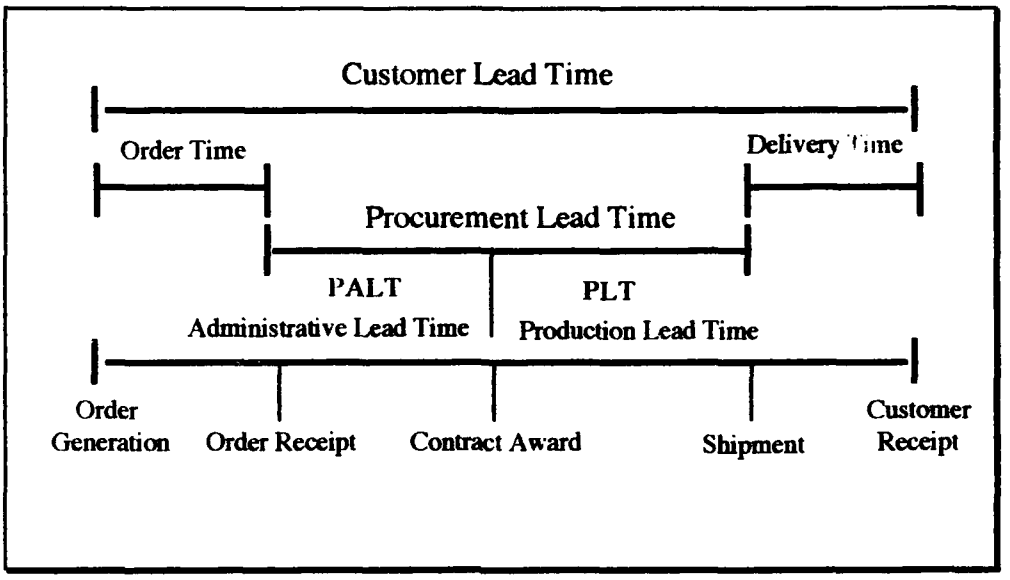


Figure 6. Lead Time Segments

3.3.2 Cancellation Rate. Brusky and Burton outlined the types of problems FMS customers faced with previous non-standard support by describing the "fate" of all of the calendar year 1988 non-standard requisitions submitted through the SAMIS (see Table 6). Of the 25,147 non-standard item requisitioned that year, 9,076 (35%) were identified only by part number and 16,071 had NSNs. Of these 9,076 part numbered requisitions, 299 (3%) translated into good NSNs which could be delivered from stock and the remaining 97% (8,777) were placed on backorder. Subsequently, 51% of these (4,512) were canceled (either by the customer or the Source of Supply [SOS]). Nine months later, 27% (2,394) showed no procurement action taken. The 16,071 stock listed requisitions fared a little better. While 28% (4,441) of the stock listed items were delivered from stock, 72% (11,630)

TABLE 6.

CY 88 REQUISITION PERFORMANCE (Brusky, 1990: 82)

AFLC Requisition Performance (CY 88) Grand Total (All NSN Requisition): 25,147						
	Total	Delivered from Stock	Back ordered	Canceled	Status at 9 Months	
					Supply Action	No Action
Part Number	9,076	299	8,777	4,512	4,265	2,394
	36%	3%	97%	51%	73%	27%
NSN	16,071	4,441	11,630	3,371	8,259	3,359
	64%	28%	72%	29%	71%	29%

items were backordered. In terms of cancellations, (29% or 3,371) of these were subsequently canceled. Nine months later, while 8,259 showed some supply action, 29% (3,359) still showed no action. To the customer, a 51% cancellation rate (the percentage of requisitions canceled when compared to the total number received) for part number requisitions and 29% for those that are stock listed translates into over 30% of their requirements not being met (Brusky, 1991: 82). While NIPARS' prime contractor award fee is predicated on maintaining a contractual standard, the ALCs have not necessarily been held accountable for controlling their cancellation rates. Historically, AFMC (as a total population) were cancelling 40% of all non-standard requisitions before the inception of NIPARS (Pugh, 1992: 4). SCT's mandated cancellation rate is less than 13% and, as of 16 March 1992, had cancelled less than 2% of the requirements it received (Brusky, 1992). However, another important aspect of this discussion is the time required to cancel an order. The time between submission of a requisition and its subsequent status feedback is time the customer cannot pursue alternate methods of acquiring a part. Therefore, the time to cancel is more important than the number of requisitions cancelled.

3.3.3 Costs. Although not a traditional measure of customer service, costs represent an important trade-off between the methods used for the delivery of service to the customer, the level of service expected by the customer, and the perceptions of the actual quality of service received by the customer. The customer generally evaluates the quality of service received in light of the cost of the services provided. For example, if the service is more costly, or is perceived as more costly, then the customer is more likely to expect a higher level of service quality compared to one available at a lesser cost. As a result, the customer tends to associate higher costs with better service. Therefore, it may be that significant changes in the server's performance, represented by PLT, PALT, and the time required to cancel, may also be accompanied by changes in costs. Since NIPARS represents changes in these performance levels, it is also important to examine any changes in cost when evaluating the delivery of customer service. If NIPARS experiences higher costs than previous methods then it would be reasonable to assume that the customers' expectations of service have increased as well. Additionally, the degree to which the customer critically evaluates the performance of the service delivery system increases as the cost of service goes up.

3.4 Expectations and Perceptions of Customer Service

Hesket, Sasser, and Hart write: "absolute measurements of service that do not include customer expectations miss the point" (Hesket, Sasser, and Hart, 1990: 6). Hence, the analysis of NIPARS solely through the use of lead time, the time required to cancel a requisition, and cost does not completely capture the actual quality of service delivered to the customer. Customers' expectations of both the result of a service and the way it is delivered are, at least as important to perceptions of quality as the *actual* quality delivered.

"What we receive for what we pay is the basis for measuring value in services as well as products. Our perception of what we receive in a service, however, is based both on results obtained and the manner in which the results are achieved" (Hesket, Sasser, and Hart, 1990: 5). More simply, the results obtained by the customer and the processes used to deliver the service to the customer define the quality or level of service perceived by the customer. Therefore, the customer service of NIPARS can only be evaluated as it is experienced by the consumer (Berry and Parasuraman,1991: 6–7). The provision of non–standard items can be defined as a service; since the customer does not get to see results immediately. The FMS customer cannot go into a shop and purchase an item off the shelf. This is particularly true when the FMS customer is purchasing training or some other service–related item. However, they do have some idea of the potential result of their decision to purchase an item through NIPARS. Therefore, the customer has some expectation of what service will be provided. This renders the concept of assessing the quality of service delivery based on traditional measures of performance is quite inappropriate for assessing the quality of service delivery because it represents only one part of the customer service picture (Heskett, Sasser, and Hart,1990: 114).

Under the NIPARS contract, cancellation rate and PALT are the measures used to gauge the contractors' effectiveness in providing non–standard item support. Although PLT and item costs are not used to measure the contractor's performance, they do affect customers' perceptions of the quality of service delivered. However, the process of assessing service quality begins with understanding the customers' expectations as well as determining what differences exist between customer perceptions of the service provided and what the customer originally expected. The bottom line is that the customer, not the server, defines the quality of service. Comparing this with the traditional definition of quality for manufactured products (conformance to specifications) suggests measures of customer service are defined by the server. Therefore, an appropriate assessment of customer service

can only be made by examining the customer's viewpoint of service, in addition to measuring the event-related measures of system performance.

In summary, there are two intertwined constructs of customer service. These constructs can be described such that:

> (1) customer service is an activity that occurs at the (provider–customer)... interface;
>
> (2) customer service is an evaluative measure, hence, (the time to cancel a requisition, PALT, *perceived* cost, and PLT) in themselves are not customer service—rather it is the performance of these functions that constitutes customer service. (LaLonde and Zinser, 1976: 271)

3.5 Quality of Service

The quality of service received by a customer (good or bad) is the result of a difference between a customer's perception of service and his or her expectations of the service. Therefore, "the only criteria that count in evaluating service are defined by the customer" (Zeithaml and others, 1990: 16).

The systems which provide information on customer's perceptions of service quality do more than provide signals for decision makers (Johnson and Kaplan,1987: 174–176). The numbers produced by these systems are often used as a basis for the formation of overlapping sets of contracts between service providers and the consumers of the services provided. Their benefit depends on how people react to and use this information.

There have been numerous systems developed to measure the quality of a manufactured product. However, service quality is intangible because it is not an object. In reviewing the literature of quality, Parasuraman and Berry (1984) suggest that the current literature of service quality has three underlying themes:

1. Service quality is more difficult for the customer to evaluate than goods quality.

2. Consumers' service quality perceptions result from a comparison of their expectations with actual service performance.

3. Quality evaluations are not made solely on the outcome of a service; they also involve evaluations of the *process* of service delivery. (Parasuraman and Berry, 1984: 2-3)

As a consequence, they identified five dimensions of how customers think about the quality of customer service. These dimensions are used by customers in evaluating the level of service provided from a systems perspective. They are: reliability (the ability to perform the service dependably, accurately, and consistently), responsiveness (the willingness to provide prompt service and help customers), competence (employees' knowledge, courtesy, and ability to instill trust and confidence), empathy (caring, individualized attention to customers), and tangibles (the physical facilities, equipment, and appearance of personnel). These measures (Table 7) were found to be readily identifiable and robust through a rigid process of scale refinement over several years and 10,000 respondents. These dimensions have been incorporated into the SERVQUAL (service quality) psychometric testing instrument. Their relationship to the customer assessment of service quality is expressed in Figure 7 and supplies the theoretical underpinnings for examining the delivery of customer service by a business function conducted under the auspices of a government-to-government transaction.

These dimensions provide a mechanism for the analytical assessment of service quality to the customer (Zeithaml and others, 1990: 2, 36). Of these, Berry and Parasuraman strongly contend, "Service reliability —*performing the service dependably and accurately*— is the heart of delivering (quality customer service). When a company performs a service carelessly, when it makes avoidable mistakes, when it fails to deliver on alluring promises

made to attract customers, it shakes the customer's confidence in its capabilities and undermines its chances of earning a reputation for service excellence" (Berry and Parasuraman,1991: 15). If reliability is the heart of customer service, then responsiveness is it's nervous system. In terms of NIPARS and this thesis, traditional measurements such as PALT, PLT, average time to cancel, and cost can be related to the dimensions of Reliability and Responsiveness. They are related to reliability in terms of their variability.

TABLE 7.

CUSTOMER SERVICE MEASURES

Dimension	Definition	Area of Evaluation
Reliability	Ability to perform the promised service dependably and accurately	System Performance
Responsiveness	Willingness to help customers and provide promised service.	System Performance
Competency	Possession of the required skills and knowledge to perform the service.	Service Personnel
Empathy	Politeness, respect, consideration, and friendliness of contact personnel.	Service Personnel
Tangibles	Appearance of physical facilities, equipment, personnel, and communications materials.	Service Environment

As PALT, PLT, average time to cancel, and cost become more variable, the perceived quality of customer service decreases. Similarly, they are also related to responsiveness in terms of the actual time required to perform the service. Cost impacts perceptions of customer

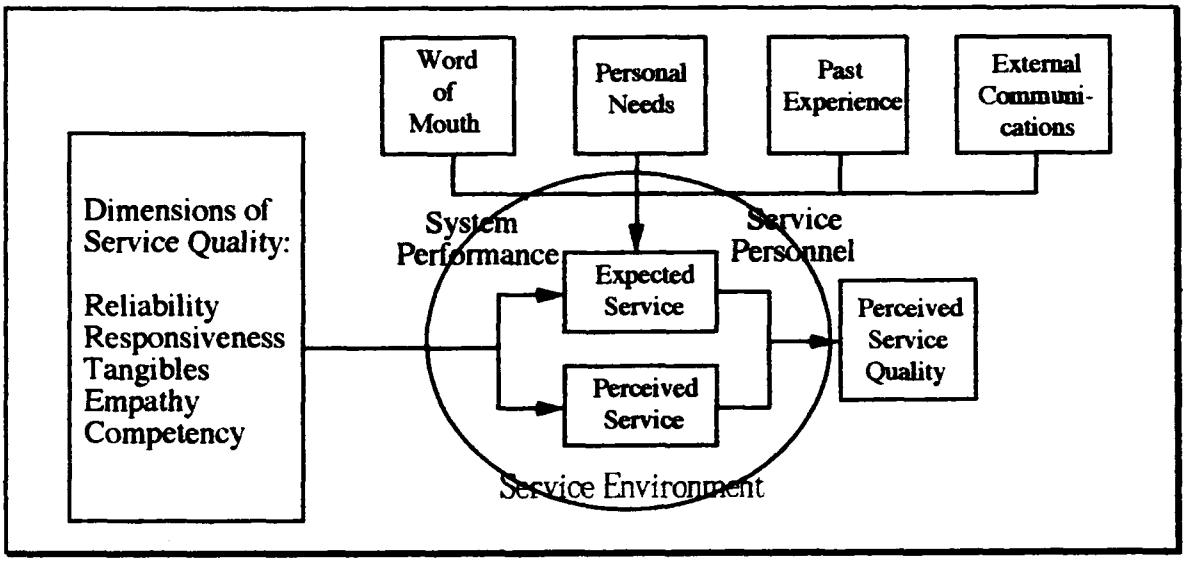


Figure 7. Customer Assessment of Service Quality (Zeithaml, 1990: 23)

service by providing a metric through which the customer forms expectations of the service he or she desires. In general, as costs rise, expectations of service increase and the tolerance of indifferent or variable service decreases. Despite the emphasis of this discussion on reliability, all of the service quality dimensions combine to create a total impression of customer service. As a consequence, while service reliability and responsiveness are directly related to the conceptions of the customer service delivered by NIPARS, all five factors have a significant impact on the quality of service expected and the perceptions of service subsequently delivered to the customer.

3.6 Summary

The literature reviewed in this chapter provides the basis for discussing customer service as a product of a logistics system. It accomplishes this by comparing the traditional measures of system performance as they relate to customer service. Lead time was defined and related to customer service in terms of the objective performance measurement factors used by NIPARS (cancellation rate and PALT). Additionally, PLT and cost were discussed as factors affecting customers' perceptions of the quality of service

delivered. This chapter then related these measures to customer expectations of the service they receive under the NIPARS contract. The next chapter discusses the statistical and sampling methodology used to evaluate the NIPARS program.

IV. Methodology

4.1 Overview

This research is composed of two parts. The first area is a formal study of historical system performance measures. An *ex post facto* design was utilized to collect and analyze secondary data because the problem statement does not lend itself to an experimental design. *Ex post facto* research design is characterized by a situation where "investigators have no control over the variables in the sense of being able to manipulate them. They can only report what has happened or what is happening" (Emory, 1991: 141). Therefore, the investigators must properly define the data populations because the sampling plan greatly affects the results of the research. The second part of the study involves the formal descriptive analysis of perceptions and expectations of customer service using primary data collected using a survey instrument.

4.2 Method of Analysis For Hypotheses One and Two

The initial focus of the research was a comparison of NIPARS performance measures to those collected under previous methods of non-standard support. This evaluation investigated possible lead time and cost variances between the two systems according to the investigative questions (listed in Table 8) designed to support the hypotheses of this research. The data required for analysis was secondary data because it was not derived from experimentation but taken from existing sources (the Security Assistance Management Information System (SAMIS) and JO41 (the Acquisition and Due-In System). The population of the data was dependent on the investigative question. Sample variables consisted of the time to cancel requisitions, PALT, PLT, and unit price data fields from both pre- and post-NIPARS requisition histories. Initial evaluation of these fields in the two

samples was accomplished via a large sample size test of hypothesis (TOH). This analysis evaluated the two samples to determine if there are any statistical differences between them where $\alpha = .05$.

TABLE 8.

HYPOTHESES AND INVESTIGATIVE QUESTIONS FOR REQUISITION CANCELLATION RATE, PALT, PLT, AND COST VARIABILITY

Hypothesis 1

A significant difference exists in the measures of performance for non-standard items under NIPARS as versus the previous methods used to provide this support.

Investigative Questions

1.1 Is there a difference between the average time to cancel a requisition for non-standard items under NIPARS versus the previous methods used to provide these items?

1.2 Is there a difference between the PALT for non-standard items under NIPARS versus the previous methods used to provide this support?

1.3 Is there a difference between the PLT for non-standard items under NIPARS versus the previous methods used to provide this support?

1.4 Is there a difference between the PALT for non-standard items procured under NIPARS versus AF procurement of standard items?

1.5 Is there a difference between the PLT for non-standard items procured under NIPARS versus the PLT for AF procurement of standard items?

Hypothesis 2

A significant difference exists in the costs of non-standard item parts under NIPARS as versus the previous methods used to provide this support.

Investigative Questions

2.1 Is there a difference between the material cost for non-standard items under NIPARS as versus the unit price for Air Force procured non-standard items?

2.2 Is there a difference between the total costs for non-standard items under NIPARS versus the total costs for Air Force procured non-standard items?

The two sample TOH is a test which determines if the "two samples have been drawn from populations with different means. In this situation the concern is not with the absolute values of the population means, but rather with the magnitude of the difference between them" (Henkel, 1976: 63). In this situation the null hypothesis is typically:

$$H_o: \mu_1 - \mu_2 = 0$$

or, alternately,

$$H_a: \mu_1 = \mu_2 = \mu$$

Expressed in words, the hypothesis is that there is no difference in the means of the populations sampled, or that the means of the two populations are the same (Henkel, 1976: 61-62).

p-values were also computed for the samples because they report "the extent to which the test statistic disagrees with the null hypothesis" (McClave and Benson, 1991: 361). Hence, it gives the probability that the alternate hypothesis is true. As a result, readers of this analysis can draw their own conclusion regarding the TOH reported in this document. As an example, if the readers of this analysis chose a different α, from what was evaluated in this document, they could evaluate whether or not they would reject the null hypothesis if the calculated *p*-value is less than their chosen value for α (McClave and Benson, 1991: 361-363).

4.3 Data Selection

4.3.1 Overview of Data Selection. The data was selected to compare pre-NIPARS and post-NIPARS performance as measured by production lead time, procurement administrative lead time, requisition cancellation statistics, and price. Record selection was based on meeting certain criteria based on MILSTRIP (Military Standard Requisitioning and Issue Procedures) codes. These codes were either document identifier codes or supply status codes. The document identifier code of interest for this study was the "AS_" transaction code, indicating a requisition's shipment. Supply status codes used were "BV", indicating requisition was on contract; "P2", indicating the SAMIS system had received 'on contract' notification from the JO41 system; "PQ", showing a price quote had been sent to SAMIS; and "CJ" or "CA" indicating contractor/inventory control point (ICP) cancellation.

Standard items were used, in addition to non-standard items, as a basis for comparison to determine if NIPARS support was significantly different from that which the Air Force provides for its "normal" requisitions. An insignificant difference might imply that non-standard items themselves create the difficulty in providing support, rather than the service provider being part of the difficulty. As such there were eight data sets used to answer the hypotheses and Investigative questions posed in this study (See Table 9).

TABLE 9.

RELATIONSHIP BETWEEN DATA SETS AND INVESTIGATIVE QUESTIONS

Data Set	Category of Analysis	Standard/ Non-standard *
One	AF PALT	Standard items
Two	AF PLT & PALT	Standard items
Three	AF PALT	Non-standard items
Four	AF PLT	Non-standard items
Five	NIPARS PALT	
Six	NIPARS PLT	
Seven	AF & NIPARS Price	
Eight	AF & NIPARS Time to Cancel	
* Note: Standard and non-standard items procured by the USAF are used to build a better picture of where NIPARS system performance fits into the total FMS logistics picture.		

When undertaking cross-sectional studies of event-related ex post facto data, one must consider whether the population was selected based on the event or on the cross-sectional parameters. For example, if our sample population is defined as the period from 1 January 1991 to 1 January 1992, requisitions submitted within that time frame will accrue supply status over the period. However, requisitions that entered the system on the first of January (date of SAMIS receipt) will have a supply status that simply indicates receipt of the requisition, while those in the system in 31 December will include both new requisitions and those from the first of January. If the objective is to measure the number of requisitions on contract (assuming the average time to contract award is greater than 30

days) the first 30 days of data will reflect a very small number of requisitions which meet the criterion. If on the other hand, we selected all requisitions that were on contract between the period of 1 January and 1 February, we would then look outside the cross-sectional data parameters for the dates of SAMIS receipt in order to compute the age of the requisition. This method means the population is defined as all requisitions on contract while the former method has as its population all requisitions received within a specified period. The first method selects all requisitions submitted within the time frame regardless of status, while the second method selects only those requisitions having the desired status within the time frame regardless of date of submission. For the purposes of the study, we selected the second method of defining all data sets used in the study.

4.3.2 PALT and PLT. Fair comparison of pre- and post-NIPARS implementation required the use of the same "yardstick" for both systems. For this reason, the PLT and PALT statistics were computed with the measures commonly used at ALCs. PALT was defined as the date of "BV" or "P2" status posting in SAMIS minus the SAMIS receipt of requisition date (rather than date of contractor receipt). This slightly skewed the data in favor of ALC statistics; however, since the objective was to measure NIPARS system performance rather than contractor performance, this skewness was assumed as not significant. PLT was defined as the shipping date (date of "AS_" transaction posting in SAMIS) minus the date of contract award as represented by "BV" or "P2" status assignment in SAMIS. Both of these measures rely on the accuracy of status assignment in the SAMIS system. The contractor has a mandatory requirement to post status within 24 hours of event occurrence, which in turn, contributes toward the amount of award fee received. The ALCs are not subject to this same financial reward for prompt system updates, and may, as a result, be less rigorous in the promptness of their status posting. This could also slightly skew the results in favor of the contractor; however, no compensation could be made for these potential biases since the objective was to measure performance not motivation.

Under the NIPARS contract, the contractor may send certain status to SAMIS to "turn off the PALT clock." This was done to avoid jeopardizing the contractor's award fee when reasons for delay are not within the contractor's control. For example, when a price quote is sent back through SAMIS to the customer for agreement to purchase at that price, the PALT clock is turned off until approval is received. This prevents the contractor from being held responsible for delays in procurement that could be created by a customer–generated delay to respond. ALCs do not have this latitude. SAMIS–collected data for AFMC is simply the difference between date of requisition receipt and the date status was posted to indicate a contract had been awarded. The method used to collect PALT data for the contractor was identical to that used by the ALCs and ignored this "free time" allowing equal comparison between the two systems.

4.3.3 Price. The issue of determining how pre– and post–NIPARS system implementation has affected the price of a product evokes considerable emotional debate. Therefore, the rational investigation of costs required the precise statement of the methodology and assumptions used in this study. To begin, two cost comparisons were made in this study. The first was strictly based on unit cost as an approximation of material cost. The second was based on the comparison of the additional fees and charges, in addition to unit cost, collected as the total cost of doing business under pre–NIPARS methods to those used by NIPARS. There were three assumptions which were made to reduce the problem to manageable dimensions. The first assumption was that the cost data for the last procured price of the item was representative of the unit cost at that time. Considerations could not be made for quantity discounts or lot buys, nor could we infer that a procurement for a quantity greater than one necessarily implied the unit cost for only one would be higher. When comparing unit prices, appropriate comparisons could not be made between item prices from 1977 and those charged in 1992 without compensating for the effects of inflation. The inflation index used to generate the adjusted unit price(s)

and total costs was the 14 February 1992 USAF Raw Inflation Indices (AFR 173–13, Attachment 45). Therefore, the second assumption was that the raw inflation indices used to inflate the unit costs to 1992 process was a useful representation of the price increases each item had been subjected to over time. The third assumption was that all of the pre-NIPARS non-standard cases were subject to the same surcharges, regardless of case. In this case we assumed all unit prices had to be inflated by a 3 percent administrative surcharge, a 1.5 percent logistics surcharge, and a 5 percent non-standard case surcharge. This 9.5 percent total surcharge rate was applied to all ALC-procured unit prices in computing total cost of the items. The specific fees for NIPARS procured items were computed from the tables presented in Chapter 3.

In Investigative Question 2.1, the unit costs for the last ALC–procured price as well as NIPARS unit prices were adjusted to reflect 1991 dollars. These inflated unit costs were subsequently compared in Investigative Question 2.1. This data was subsequently multiplied by their appropriate administrative surcharge factors for each logistics system to compare the total costs to the customer, in Investigative Question 2.2

4.3.4 Cancellation Rate. Cancellation comparisons were made only on those cancellations created by the NIPARS contractor or the item manager. Our intent was to eliminate the impact of the occasional spikes in cancellations caused by events beyond NIPARS or Item Manager control. For example, a country may have open requisitions canceled at State Department level direction for political or financial reasons. One illustration involves a country's recent political actions causing the State Department to direct suspension of case activity and cancellation of their open requisitions. In another case, a country's oversight during implementation of a new supply system created several thousand requisitions in one day rather than over the intended period of several months. The resulting over-commitment of their FMS funds caused Case/Country managers to cancel many of these requisitions. In both of the above cases and others that are similar in

nature, the cancellation codes entered indicate customer cancellation. It was important to separate these "aberrations" from the system performance measure so they did not skew the averages. Other reasons for customer cancellation of requisitions tend to be either discovering the wrong material was requisitioned or disagreement with the price quote. A policy exists to inform the customer any time the requisition price exceeds 10% of the catalog price. These cancellations are also beyond the control of NIPARS or the Item Manager (IM). Therefore, capturing the data without customer-generated cancellations eliminated this potential source of "system noise." Reasons for contractor cancellation or item manager cancellations tended to be primarily for items that could not be identified for procurement. Our desire was to compare the number of contractor/IM cancellations for this cause. We felt these statistics presented a clearer comparison between the performance of the NIPARS system and that of the inventory control points (ICPs). Although we have considered capturing data to compare cancellation rates for disagreement with price quotes, capturing this data for the Air Force ICPs was not feasible. Also, while a higher rate for the contractor might indicate a customer perception that price was too high, it would be difficult to prove this cause-effect relationship.

4.3.5 Data Integrity. One last potential source of bias must be discussed. As with any study that relies on ex post facto data from a database, we assumed the integrity of the SAMIS database was not in question. While this may not be a totally realistic assumption, we could not speculate on the size of the effect of data integrity on our study and therefore could not compensate for any affect which might have been present.

4.3.6 Data Set One.

4.3.6.1 Population of Data Set One. All Security Assistance requisitions with Air Force ICPs filled from contract with BV status (shipped or not) between January 1991 and June 1992.

4.3.6.2 Explanation of Data Set One. This data set looked at all Air Force Security Assistance requisitions for standard items which were placed in "BV" or "P2" status during the last 18 months (January 1991-June 1992). We selected this time frame as an arbitrary point that should exclude data from NIPARS system start-up to "steady-state" conditions. (Actual data retrieval and plotting of these points to determine realistic "steady state" conditions was not feasible.) Data Set 1 results were used for comparison with those generated from Data Set 5, NIPARS requisitions with "BV" status. This resulted in a comparison of how well NIPARS performed as compared to standard support generated by the ALCs.

4.3.7 Data Set Two.

4.3.7.1 Population of Data Set Two. All Security Assistance (SA) requisitions with AF ICPs filled from contract with shipped status between January 1991 and June 1992.

4.3.7.2 Explanation of Data Set Two. This data set looked at all Air Force Security Assistance requisitions for standard items which were placed in shipped status during the last 18 months (January 1991-June 92). The rationale for selecting this period was the same as that used for Data Set 1. Data Set 2 results were used for comparison with those generated from Data Set 6, NIPARS requisitions which had been shipped. This resulted in a comparison of how well NIPARS performed as compared to standard support generated by the ALCs.

4.3.8 Data Set Three.

4.3.8.1 Population of Data Set Three. All non-standard item (NSI) requisitions with AF ICPs with BV status provided between 1 March 1989 and 30 August 1990.

4.3.8.2 Explanation of Data Set Three. This data set looked at all Air Force Security Assistance requisitions for non-standard items which were placed in "BV" status during the period 1 October 1989 to 30 September 1990. This time period represented the last year prior to NIPARS implementation that AF ICPs provided non-standard item support. Data Set 3 results were used for comparison with those generated from Data Set 5, NIPARS requisitions with "BV" status. This resulted in a comparison of how well NIPARS performed as compared to non-standard support generated by the ALCs.

4.3.9 Data Set Four.

4.3.9.1 Population of Data Set Four. All NSI requisitions with AF ICPs filled from contract with shipped status provided between 1 March 1989 and 30 August 1990.

4.3.9.2 Explanation of Data Set Four. This data set looked at all Air Force Security Assistance requisitions for non-standard items which were shipped during the period 1 October 1989-30 September 1990. This time period represented the last year prior to NIPARS implementation that AF ICPs provided non-standard item support. Data Set 4 results were used for comparison with those generated from Data Set 6, NIPARS requisitions which had been shipped. This resulted in a comparison of how well NIPARS performed as compared to non-standard support generated by the ALCs.

4.3.10 Data Set Five.

4.3.10.1 Population of Data Set Five. All NIPARS requisitions with BV status between January 1991 and June 1992, inclusive.

4.3.10.2 Explanation of Data Set Five. This data set looked at all NIPARS requisitions which were placed on BV status between January 1991 and June 1992. Data set results were used for comparison with those generated in data sets 1 through 4. This resulted in a comparison of how well NIPARS performed as compared to both current support of standard items and pre-NIPARS non-standard support by the ALCs.

4.3.11 Data Set Six.

4.3.11.1 Population of Data Set Six. All NIPARS requisitions with shipped status between January 1991 and June 1992.

4.3.11.2 Explanation of Data Set Six. This data set looked at all NIPARS requisitions which were shipped between January 1991 and June 1992. Data set results were used for comparison with those generated in data sets 1 through 4. This resulted in a comparison of how well NIPARS performed as compared to both current standard support and pre-NIPARS non-standard support by the ALCs.

4.3.12 Data Set Seven.

4.3.12.1 Population of Data Set Seven. The population of unit prices was obtained by identifying NSNs requisitioned from AF ICPs and subsequently shipped from contract (not stock shipment) during the period 1 March 1989 and 30 August 1990 which had also been requisitioned from NIPARS during the period 1 January 1991 through 30 June 1992.

4.3.12.2 Explanation of Data Set Seven. This data set looked at the unit prices of non-standard stocklisted item requisitions which the Air Force procured from

contract before NIPARS was implemented (March 1989 to August 1990) and compared those to the unit prices of same stock listed items that had been procured by the NIPARS contractor (January 1991 to June 1992). This comparison provided results that indicated if contractor prices were significantly higher than those obtained by Air Force procurement. Two caveats are placed on this extrapolation. First, if a significant amount of time has passed since the Air Force procurement occurred, an inflationary formula had to be used to attempt to insure the unit prices were truly comparable. Second, quantities purchased could significantly affect unit price. If we had reduced the already small population of unit prices that had procurement data for both the AF and NIPARS by eliminating those with significantly different quantity buys, the comparison would have been closer to a point estimate than a statistically sound result.

4.3.13 Data Set Eight.

4.3.13.1 Population of Data Set Eight. All NSI requisitions for AF ICPs as the source of supply (SOS) which were canceled by the ICP (not the customer) during the period 1 March 1989 to 30 August 1990, and requisitions for NIPARS canceled by the contractor during the period 1 January 1991 through 30 June 1992.

4.3.13.2 Explanation of Data Set Eight. This data set looked at requisitions which the Air Force canceled before NIPARS was implemented (March 1989 to August 1990) and compared those to the number of items canceled by the NIPARS contractor (January 1991 to June 1992). This comparison provided results that indicated whether the contractor took a significantly longer amount of time to cancel requisitions than Air Force ICPs.

4.4 Statistical Assumptions

Because of the large sample size used in this analysis, several assumptions were made. The first is that the data fits a normal distribution. The second was that the two samples have equal variances. These assumptions were required to use the Pearson Product Moment Coefficient of Correlation *r*. If these assumptions cannot be made, then other less powerful statistical measures must be used. However, this assumption of normality was evaluated with the Wilk–Shapiro statistic. According to Miller, the Wilk–Shapiro test is the best currently available procedure for evaluating whether or not the data has a normal distribution (Miller, 1986: 9).

Before the Air Force sample data from the ALCs was aggregated and compared to NIPARS sample data was examined to determine if there were significant differences between the ALCs providing the items in terms of some dependent variable (PALT, PLT, etc.).

> It is...not enough to simply compute the group means and examine whether they are different or not. While the means differ in numerical values we still have to investigate whether the differences are simple random variations that occurred by chance, or whether there are systematic differences between the means. (Iverson and Northpoth, 1976: 25)

The method used for accomplishing this analysis was the one–way analysis of variance (ANOVA). The hypothesis for the *F* - test for interaction is:

H_o: All ALC means are equal.

H_a: At least two of the ALC means are not equal.

If the data showed that we should reject H_o, then any results obtained by aggregating the ALC data as a group would include the caveat that the results may not be characteristic of all ALCs.

4.5 Method of Analysis For Hypothesis Three

Hypothesis 3 and its associated investigative questions are restated below in Table 10.

TABLE 10.

HYPOTHESIS THREE AND INVESTIGATIVE QUESTIONS

Hypothesis 3 The FMS customer views the NIPARS process as adequately meeting their requirements for non-standard item parts. Investigative Questions 3.1 Is the service quality (SERVQUAL) testing instrument reliable and valid indicator of the sample populations expectations and perceptions of customer service? 3.2 Do customers perceptions of service exceed their expectations of service? 3.3 Do customers view the contractual measures of performance as adequately measuring the quality of service they receive?

The final part of the research was concerned with the review of customer expectations and perceptions of the NIPARS process and its effect on the provision of non-standard items. A survey of personnel at the AFSAC who were actively involved with both the NIPARS program and the client customer was conducted. The survey utilized the "SERVQUAL" psychometric testing instrument (adapted for the NIPARS environment) to measure the service quality perceived by the customer where QUALITY OF SERVICE = ACTUAL (PERCEIVED) SERVICE - EXPECTED SERVICE. A potential bias of this methodology was the assumption that the AFSAC personnel's expectations and perceptions of customer service were representative of the logistics managers in their assigned customer countries. Survey Questions are listed in Appendix A.

4.5.1 Reliability and Validity. Although the reliability and validity of the SERVQUAL instrument had been tested thoroughly across a number of service industries in the commercial sector, this research was the first documented use in the DOD. As a result, its reliability and validity was evaluated in terms of the sample population's

expectations and perceptions of customer service. The multi-stage process used to confirm the instrument's reliability and validity utilized Cronbach's Alpha and associated tests to confirm reliability and several measures of validity to examine if the instrument measured what it was supposed to measure. Specifically, a test of hypothesis was used to determine the association between Question 27 (NIPARS does an excellent job of satisfying my need for non-standard parts.) and the overall SERVQUAL score. Hence, the convergent validity was assessed as overall perceptions of customer service should correlate with the overall SERVQUAL score. The hypothesis for testing the significance of r for is:

$$H_o: \ r = 0$$

$$H_a: \ r \neq 0$$

If the data showed that we would accept H_o then any results obtained from the questionnaire must include the caveat that they may not be valid where $\alpha = .05$.

4.5.2 Computing SERVQUAL Scores. The SERVQUAL statements in the questionnaire were grouped into the five dimension as follows:

Dimension	Statements Pertaining to the Dimension
Tangibles	Statements 1-4
Reliability	Statements 5-9
Responsiveness	Statements 10-13
Assurance	Statements 14-17
Empathy	Statements 18-22

The SERVQUAL score of the individual customer was computed from the difference between the paired expectation/perception statements in each area, and then taking the average of the scores in the area. The next step was to then multiply this score by its weight assigned by the individual customer for each of the five dimensions. The weighted scores were then averaged across the five factors to arrive at a combined weighted SERVQUAL score. Finally,

the SERVQUAL score for the group was computed by averaging all scores from the sample population within each area as well as the combined weighted score (Zeithaml et al., 1990: 176-177).

4.5.3 Contractual Measures of Performance. Statements 23 to 26 were not a part of the original SERVQUAL questionnaire. They were added to measure customer expectations and perceptions of the effect of the contractual measures of performance on customer service. The reliability and validity of these measurements was investigated using procedures analogous to those used to examine the SERVQUAL instrument. The score of this measurement was computed by subtracting individual expectation and perception scores and then averaging the difference between the scores.

4.6 Summary

This chapter described the techniques and logic used in collecting and evaluating the data required to answer the investigative questions raised in Chapter I. These questions stem from the specific management problem identified earlier in Chapter I: Has NIPARS improved the process of acquiring non standard items for the USAF FMS customer? Specifically, has the average time to cancel a requisition, PALT, PLT, and costs for the customer significantly decreased due to the implementation of NIPARS? It also described how the research used statistical analyses to investigate these questions. Finally, it addressed the reliability and validity issues associated with the use of the SERVQUAL instrument as well as defining the customer's current perceptions regarding the NIPARS process. The next chapter shows the results obtained from the study.

V. Results

5.1 Overview

This chapter begins with a discussion of the changes in statistical methodology necessitated by the characteristics of the data. This chapter also lists the statistical results for the research questions which were used to answer the three hypotheses that form the core of this thesis. Specific discussion of the results is conducted in Chapter VI.

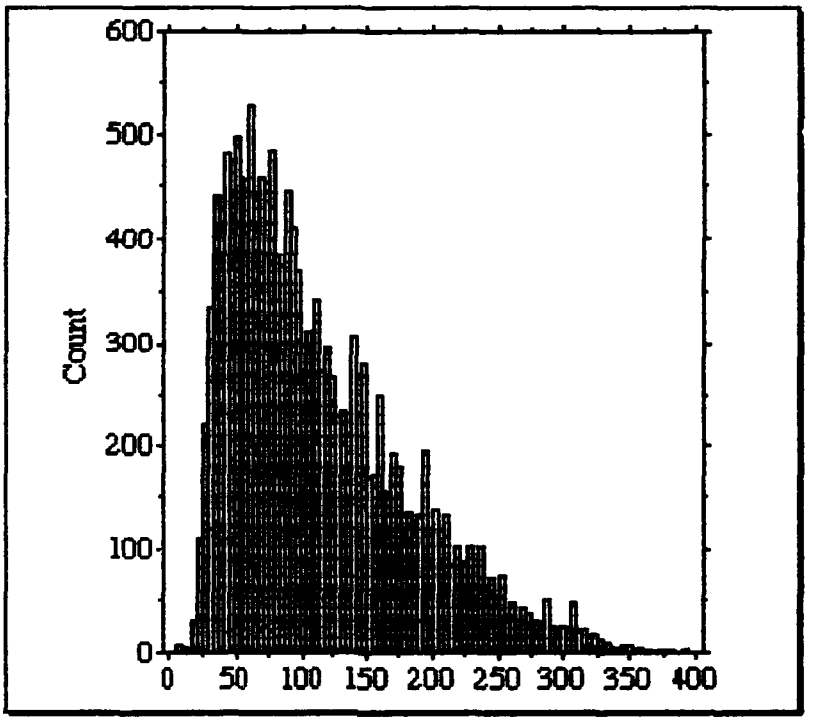
5.2 Changes in Statistical Methodology

When data sets one through eight were initially characterized through the use of the Wilk–Shapiro test, it became readily apparent that much of the data did not have a normal distribution. This can be clearly shown through the frequency histogram of NIPARS total lead time from data set 6 (Figure 8). This histogram represents the most "normal" of the distributions encountered in the study. As a result, each data set had to be analyzed through the use of a different set of procedures than had been planned. It is important that the distributions should not be considered abnormal simply because they do not exhibit the typical mound–shaped Gaussian distribution. They only require the use of different statistical procedures than those planned.

Because the data does not fulfill the necessary conditions for the use of parametric analysis, nonparametric statistics must be used to make inferences from the data. When testing a hypothesis, if a difference exists between the NIPARS unit price and the ILC unit price the Wilcoxon Matched Pairs Signed–Ranks Test was used because it represents a nonparametric substitute for paired *t* test which would have been used if the samples had met the necessary condition of normality (Senter, 1969: 238; Hendrick, 1981: 115). "This test not only considers (the magnitude and the direction of the differences of paired

FIGURE 8.

FREQUENCY HISTOGRAM OF NIPARS TOTAL LEAD TIME FROM DATA SET SIX



observations) but assigns more weight to a pair showing a larger difference than to a pair $\left(\overline{X}_1 - \overline{X}_2\right)$ showing a small difference" (Hill and Kerber, 1967: 324). If data is not paired (e.g., time to cancel, PALT, and PLT) and if N > 50, then Neter and Wilcox suggest that the Median test is more appropriate because the median and its associated statistics more accurately represent the skewed distributions found in the data (Neter and others, 1985: 642; Wilcox, 1987: 338).

The Kolmogorov–Smirnov test may also be used to clarify relationships between two samples. It will specifically to determine the agreement between the expected relative frequency distribution functions of the two samples (Hill and Kerber, 1967: 311). This may be important when trying to ascertain whether one population comes from a population

with lower values than another distribution. The typical test of hypothesis for this test is:

H_O: $rf_{n_1 k} \geq rf_{n_2 k}$

H_a: $rf_{n_1 k} < rf_{n_2 k}$

Rejection Region: $\chi^2 \geq \chi^2_{(2\,df,\alpha=.05)} = 5.99$

Conclusion: The two samples either have similar cumulative frequency distributions or they don't.

Paragraph 4.4, Statistical Assumptions, declares that before the Air Force sample data from the ALCs can be aggregated and compared to NIPARS sample data it must be examined to determine if there are significant differences between the ALCs providing the items in terms of some dependent variable (PALT, PLT, etc.). It specifies the use of the one-way analysis of variance (ANOVA) for accomplishing this analysis. The hypothesis for the *F*-test for interaction is:

H_O: All ALC means are equal.

H_a: At least two of the ALC means are not equal.

As a result, if the data showed that we must reject H_o then any results obtained by aggregating the ALC data as a group would have been caveated by saying that the results may not be characteristic of all ALCs. However, the *F*-test for the analysis of variance is not robust when the data is radically departed from normality, such as in the present case, therefore the Kruskal – Wallis test is an appropriate nonparametric substitute (Neter and others, 1982: 638; Hill and Kerber, 1967: 330). The hypothesis for the Kruskal – Wallis test is then:

H_O: All populations are identical.

H_a: All populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_0.

If $H > H_{(1-\alpha,r-1)}$, conclude H_a.

Conclusion: Either the populations are the same or further analysis is required using the large sample analog to the Bonferroni test to determine what groupings exist. ALC populations are identified by their source of supply codes listed in Table 11.

TABLE 11.

SOURCE OF SUPPLY CODES
(AF Pamphlet 67-25, Logistics Codes Desk Guide: 17)

Code	Acronym	Title
FFZ	SM-ALC	Sacramento ALC
FGZ	OO-ALC	Ogden ALC
FHZ	OC-ALC	Oklahoma City ALC
FLZ	WR-ALC	Warner-Robins ALC
FPZ	SA-ALC	San Antonio ALC

Neter and others advise that statement of the decision problems in this manner avoids the assumption "that populations are identical except for their means" (Neter and others, 1985: 640). This also makes unnecessary the use of the Bartlet test for the equality of variances, a precondition for use of the F - test. However, if the data fails to accept H_0 the reason for the deviation cannot be determined. "For example, the means might differ, or the variances, or the nature of the skewness, or some combination of these. If the Kruskal Wallis test leads to the conclusion that the factor level or treatment means are not identical, it is frequently desirable to obtain some information about the comparative magnitudes of these means" (Neter and others, 1985: 640). As a result, a large sample-testing analog of the Bonferroni pairwise comparison procedure can be employed to determine the comparative magnitudes of variability around the

treatment means (Neter and others, 1985: 640–641). The formula specified in this test is found below, where $\overline{R}$ is the mean rank of each group, n_T is the total size of the sample, n_i is the sample size of each individual sample, and r is the number of groups in the sample.

$$\left(\overline{R}_i - \overline{R}_{i'}\right) \pm B\left\{\frac{n_T(n_T+1)}{12}\left(\frac{1}{n_i}+\frac{1}{n_{i'}}\right)\right\}^{\frac{1}{2}}$$

$$B = z\left(1-\tfrac{\alpha}{2g}\right)$$

$$g = \frac{r(r-1)}{2}$$

Based on the results of following test, groups which do not differ will be set up as a group of treatment means.

H_O: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means include 0 then fail to reject H_o.

Conclusion: The two means should be grouped together.

The exact method of data analysis will be listed for each data set. Hence, the reader can evaluate the procedures used against their own experiences with nonparametric statistics.

5.3 Results for Hypothesis One

5.3.1 Investigative Question 1.1. Is there a difference between the average to time to cancel a requisition for non-standard items under NIPARS versus the previous methods used to provide these items?

5.3.1.1 Is There a Difference Between ALCs?

H_o: All ALC time to cancel populations are identical.

H_a: All ALC time to cancel populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.
If $H > H_{(1-\alpha,r-1)}$, conclude H_a.
$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 120.4$ $\rho = .0001$

Conclusion: Fail to accept H_o. All ALC time to cancel population means are not identical. As a consequence the large sample-testing analog of the Bonferroni pairwise comparison procedure must be used to determine if there are possible groupings of ALCs within the sample.

5.3.1.2 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair-wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair-wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means do not include 0 then fail to accept H_o.

Conclusion: Comparison of the individual treatment means between each ALC produced the following groupings:

Group	I	II	III
ALC Code	FHZ FGZ FLZ	FFZ	FPZ

5.3.1.3 Is There a Difference Between NIPARS and ALC Groupings?

Where μ_1 is the NIPARS average time to cancel a requisition for non-standard items and μ_2 is the ALC average time to cancel a requisition (within each grouping) for non-standard items from data set eight:

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq \chi^2_{(2df, \alpha=.05)} = 5.99$

Results: $\rho = .0001$

Group	I	II	III
χ^2	28.27	59.65	66.67

Conclusion: Fail to accept H_o. The median value of each category is significantly different. In this case, looking at the computed median values for the data samples, groups II and III are lower while group I is higher than the median value for NIPARS.

Because of the differences in results between the means and medians (see paragraph 5.3.1.4) of the two sample populations, an analysis of their populations was conducted using the Kolmogorov–Smirnov test to ensure adequate analysis of the sample populations. In the following test of hypothesis (TOH) $rf_{n_1 k}$ is the data forming the time to cancel a requisition from NIPARS and $rf_{n_2 k}$ is the data from the ALC groupings.

H_O: $rf_{n_1 k} \geq rf_{n_2 k}$

H_a: $rf_{n_1 k} < rf_{n_2 k}$

Test Statistic: Kolmogorov–Smirnov test

Rejection Region: $\chi^2 \geq \chi^2_{(2\,df,\alpha=.05)} = 5.99$

Results:

Group	I	II	III
$\chi^2_{(calc)}$	2.36	2.87	571.1

Conclusion: ALC groupings I and II come from populations with smaller time to cancel values than NIPARS. ALC grouping III population comes from a population with larger values than NIPARS.

5.3.1.4 Descriptive Statistics for Investigative Question 1.1.

Category	NIPARS	I	II	III
Activity	NIPARS	FPZ	FFZ	FGZ FHZ FLZ
Mean (days)	142	214	320	334
S.D. (days)	85	402	510	394
Median (days)	112	5	14	233
Min.. (days)	14	1	1	1
Max.. (days)	386	2411	3232	2326
Number	63	1525	7011	1058
Skewness	1.9	1.3	1.6	1.6
Kurtosis	4.4	1.6	2.3	2.7

5.3.2 Research Question 1.2. Is there a difference between the PALT for non-standard items under NIPARS versus the previous methods used to provide this support? Two sample populations were available to evaluate the PALT of the ALCs. The first population consisted of those items which had been placed on contract. The second sample population consisted of those items which had been shipped. Comparison of PALT statistics between these two sample populations resulted in different ALC groupings. As a result, each population's PALT statistics were compared to those of NIPARS separately.

5.3.2.1 Is There a Difference in PALT Between ALCs (Using On Contract Population)?

H_o: All ALC PALT populations are identical.

H_a: All ALC PALT populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.
If $H > H_{(1-\alpha,r-1)}$, conclude H_a.
$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 393.29$ $\rho = .0001$

Conclusion: Fail to accept H_o. All ALC PALT population means are not identical. As a consequence the large sample-testing analog of the Bonferroni pairwise comparison procedure was used to determine if there were possible groupings of ALCs within the sample.

5.3.2.2 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair-wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair-wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means do not include 0 then fail to accept H_o.

Conclusion: The ALCs should be grouped as follows:

Group	I	II	III
ALC	FHZ	FPZ	FFZ
Code	FGZ	FLZ	

5.3.2.3 Is There a Difference in PALT Between NIPARS and ALC Groupings?

Where μ_1 is the NIPARS PALT from data set five and μ_2 the ALC PALT for non-standard items in each group from data set three.

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq 3.84$

Results: $\rho = .0001$

Group	I	II	III
χ^2	328	577	443

Conclusion: Fail to accept H_o. The median PALT value of each category is significantly different (in this case, the value is larger) than the median PALT value for NIPARS.

5.3.2.4 Descriptive Statistics for Investigative Question 1.2.

Category	NIPARS	I	II	III
Activity	NIPARS	FFZ	FPZ FLZ	FHZ FGZ
Mean (days)	82	278	321	369
S.D. (days)	66	302	315	446
Median (days)	12	203	247	316
Min. (days)	12	1	8	4
Max. (days)	420	1937	1513	1871
Number	823	1503	1725	449
Skewness	1.9	1.6	1.6	1.3
Kurtosis	4.4	2.7	2.3	1.6
Wilk-Shapiro	.8097	.8386	.8186	.8843

5.3.2.5 Is There a Difference in PALT Between ALCs (Using Shipped Population)?

H_o: All ALC PALT populations are identical.

H_a: All ALC PALT populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.

If $H > H_{(1-\alpha,r-1)}$, conclude H_a.

$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 110.45$ $\rho = .0001$

Conclusion: Fail to accept H_o. All ALC PALT population means are not identical. As a consequence the large sample-testing analog of the Bonferroni pairwise comparison procedure was used to determine if there were possible groupings of ALCs within the sample.

5.3.2.6 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair-wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair-wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means do not include 0 then fail to accept H_o.

Conclusion: The ALCs should be grouped as follows:

Group	I	II	III	IV
ALC Code	FHZ FGZ	FLZ	FFZ	FPZ

5.3.2.7 Is There a Difference in PALT Between NIPARS and ALC Groupings?

Where μ_1 is the NIPARS PALT from data set five and μ_2 is the AF PALT for non-standard items from data set four:

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq 3.84$

Results: $\rho = .0001$

Group	I	II	III	IV
χ^2	248	80	664	443

Conclusion: Fail to accept H_o. The median PALT value of each category is significantly different (in this case, the value is larger) than the median PALT value for NIPARS.

5.3.2.8 Descriptive Statistics for Investigative Question 1.2.

Category	NIPARS	I	II	III	IV
Activity	NIPARS	FGZ FHZ	FLZ	FFZ	FPZ
Mean (days)	82	290	330	355	423
S.D. (days)	66	336	364	343	367
Median (days)	60	198	221	256	316
Min. (days)	12	1	4	8	4
Max. (days)	420	4208	3918	3791	4193
Number	823	935	541	1670	449
Skewness	1.9	3.9	3.0	2.4	3.3
Kurtosis	4.4	35.5	18.8	12.4	24.6
Wilk-Shapiro	.8097	.7188	.7321	.7827	.7729

5.3.3 Research Question 1.3. Is there a difference between the PLT for non-standard items under NIPARS versus the previous methods used to provide this support?

5.3.3.1 Is There a Difference in PLT Between ALCs?

H_o: All ALC PLT populations are identical.

H_a: All ALC PLT populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.
If $H > H_{(1-\alpha,r-1)}$, conclude H_a.
$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 120.3$ $\rho = .0001$
Conclusion: Fail to accept H_o. All ALC population PLT means are not identical. As a consequence the large sample-testing analog of the Bonferroni pairwise comparison procedure must be used to determine if there are possible groupings of ALCs within the sample.

5.3.3.2 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair-wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair-wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means do not include 0 then fail to accept H_o.

Conclusion: The ALCs should be grouped as follows:

Group	I	II	III
ALC Code	FHZ FGZ	FFZ FLZ	FPZ

5.3.3.3 Is There a Difference in PLT Between NIPARS and ALC Groupings?

Where μ_1 is the NIPARS PLT from data set six and μ_2 is the AF PLT for non-standard items from data set four:

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq 3.84$

Results: $\rho = .0001$

Group	I	II	III
χ^2	414	793	661

Conclusion: Fail to accept H_o. The mean PLT value of each category is significantly different (in this case, the value is larger) than the mean PLT value for NIPARS.

5.3.3.4 Descriptive Statistics for Investigative Question 1.3.

Category	NIPARS	I	II	III
Activity	NIPARS	FGZ FHZ	FFZ FLZ	FPZ
Mean (days)	56	179	241	317
S.D. (days)	51	159	175	185
Median (days)	37	134	189	319
Min. (days)	1	1	1	1
Max. (days)	307	834	1063	973
Number	826	923	1951	515
Skewness	2.0	1.5	1.2	0.5
Kurtosis	3.9	2.2	1.2	-0.8
Wilk-Shapiro	.7741	.8462	.9067	.9701

5.3.4 Research Question 1.4. Is there a difference between the PALT for non-standard items procured under NIPARS versus the PALT for AF procurement of standard items? Two sample populations were available to evaluate the PALT of the ALCs. The first population consisted of those items which had been placed on contract. The second sample population consisted of those items which had been shipped. Comparison of PALT statistics between these two sample populations resulted in different ALC groupings. As a result, each population's PALT statistics were compared to those of NIPARS separately.

5.3.4.1 Is There a Difference in PALT Between ALCs (Using on Contract Population)?

H_o: All ALC PALT populations are identical.

H_a: All ALC PALT populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.

If $H > H_{(1-\alpha,r-1)}$, conclude H_a.

$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 120.39$ $\rho = .0001$

Conclusion: Fail to accept H_o. All ALC PALT population means are not identical. As a consequence the large sample–testing analog of the Bonferroni pairwise comparison procedure must be used to determine if there are possible groupings of ALCs within the sample.

5.3.4.2 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair–wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair–wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means do not include 0 then fail to accept H_o.

Conclusion: The ALCs should be grouped as follows:

Group	I	II	III
ALC Code	FHZ FGZ FLZ	FFZ	FPZ

5.3.4.3 Is There a Difference in PALT Between NIPARS and ALC Groupings for Standard Items (Using on Contract Population)?

Where μ_1 is the NIPARS PALT from data set five and μ_2 is the AF PALT for standard items from data set one.

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq 3.84$

Results: $\rho = .0001$

Group	I	II	III
χ^2	787	583	1029

Conclusion: Fail to accept H_o. The median PALT value of each category is significantly different (in this case, the value is larger) than the median PALT value for NIPARS.

5.3.4.4 Descriptive Statistics for Investigative Question 1.4.

Category Activity	NIPARS NIPARS	I FGZ FHZ FLZ	II FFZ	III FPZ
Mean (days)	82	364	712	494
S.D. (days)	66	322	434	369
Median (days)	60	302	632	412
Min. (days)	12	1	43	10
Max. (days)	420	1811	1588	1997
Number	823	1773	407	1590
Skewness	1.9	1.0	2.7	8.8
Kurtosis	4.4	6.5	-1.4	1.7
Wilk-Shapiro	.8097	.9076	.8988	.9221

5.3.4.5 Is There a Difference in PALT Between ALCs for Standard Items (Using Shipped Population)?

Where μ_1 is the NIPARS PALT from data set five and μ_2 is the AF PALT for standard items from data set two.

H_o: All ALC populations are identical.

H_a: All ALC populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.

If $H > H_{(1-\alpha,r-1)}$, conclude H_a.

$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 631.76$ $\rho = .0001$

Conclusion: Fail to accept H_o. All ALC PALT population means are not identical. As a consequence the large sample-testing analog of the Bonferroni pairwise comparison procedure must be used to determine if there are possible groupings of ALCs within the sample.

5.3.4.6 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair-wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair-wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means does not include 0 then fail to accept H_o.

Conclusion: The ALCs should be grouped as follows:

Group	I	II	III
ALC Code	FFZ	FGZ FPZ	FLZ FHZ

5.3.4.7 Is There a Difference in PALT Between NIPARS and ALC Groupings for Standard Items (Using Shipped Population)?

Where μ_1 is the NIPARS PALT from data set five and μ_2 is the AF PALT for standard items from data set two.

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq 3.84$

Results: $\rho = .0001$

Group	I	II	III
χ^2	418	907	1047

Conclusion: Fail to accept H_o. The median PALT value of each category is significantly different (in this case, the value is larger) than the median PALT value for NIPARS.

5.3.4.8 Descriptive Statistics for Investigative Question 1.4.

Category Activity	NIPARS NIPARS	I FFZ	II FPZ FGZ	III FHZ FLZ
Mean (days)	82	360	395	463
S.D. (days)	66	409	395	416
Median (days)	60	308	339	364
Min. (days)	12	1	1	1
Max. (days)	420	4054	4105	4024
Number	823	1773	5428	2587
Skewness	1.9	1.0	2.7	8.8
Kurtosis	4.4	6.5	-1.4	1.7
Wilk-Shapiro	.8097	.9076	.8988	.9221

5.3.5 Research Question 1.5. Is there a difference between the PLT for non-standard items procured under NIPARS versus the PLT for AF procurement of standard items?

5.3.5.1 Is There a Difference Between ALCs?

H_o: All ALC PLT populations are identical.

H_a: All ALC PLT populations are not identical.

Rejection Region: If $H \leq H_{(1-\alpha,r-1)}$, conclude H_o.

If $H > H_{(1-\alpha,r-1)}$, conclude H_a.

$H_{(1-\alpha,r-1)} = 25.2$

Test Statistic: Kruskal Wallis Test

Results: $H = 631.76$ $\rho = .0001$

Conclusion: All ALC PLT population means are not identical. As a consequence the large sample–testing analog of the Bonferroni pairwise comparison procedure must be used to determine if there are possible groupings of ALCs within the sample.

5.3.5.2 Which ALCs Should be Grouped Together?

H_o: $\mu_1 = \mu_2$ for each pair–wise comparison between ALCs.

H_a: $\mu_1 \neq \mu_2$ for each pair–wise comparison between ALCs.

Test Statistic: Large sample analog to Bonferroni test

Rejection Region: If the testing limits for the two means does not include 0 then fail to accept H_o.

Conclusion: The ALCs should be grouped as follows:

Group	I	II	III	IV
ALC Code	FFZ	FGZ FHZ	FLZ	FPZ

5.3.5.3 Is There a Difference Between NIPARS and ALC Groupings?

Where μ_1 is the NIPARS PLT from data set six and μ_2 is the AF PLT for standard items from data set two.

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Test Statistic: Median Test

Rejection Region: $\chi^2 \geq 3.84$

Results: $\rho = .0001$

Group	I	II	III	IV
χ^2	708	1090	818	626

Conclusion: Fail to accept H_0. The median PLT value of each category is significantly different (in this case, the value is larger) than the median PLT value for NIPARS.

5.3.5.4 Descriptive Statistics for Investigative Question 1.5.

Category Activity	NIPARS NIPARS	I FFZ	II FGZ FHZ	III FLZ	IV FPZ
Mean (days)	56	764	1012	653	641
S.D. (days)	51	731	671	557	666
Median (days)	37	838	1008	786	711
Min. (days)	1	1	1	2	1
Max. (days)	307	2834	3072	2822	3009
Number	760	1083	2379	1856	3252
Skewness	1.9	4.8	7.3	5.9	8.1
Kurtosis	3.7	-1.2	-8.7	-2.1	-3.6
Wilk-Shapiro	.779	.8577	.9256	.8814	.8455

5.4 Results for Hypothesis Two

A significant difference exists in the costs of non-standard item parts under NIPARS as versus the costs of previous methods used to provide this support. All prices were economically adjusted using the USAF Raw Inflation Indices (AFR 173-13, Attachment 45, 14 February 1992).

5.4.1 Research Question 2.1. Is there a difference between the unit price for non-standard items under NIPARS versus the unit price for AF procured non-standard items?

5.4.1.1 Primary Characterization of Pricing Data. When the data (N = 336) was examined for normality using the Wilk-Shapiro test it was found to exhibit no traits of normality. This analysis was confirmed with descriptive statistics showing the high degree of kurtosis and skewness of the data shown below.

Data	Mean (dollars)	σ_s (dollars)	Median (dollars)	Skewness	Kurtosis
NIPARS	153.25	161.88	94.24	5.8	39.83
AFSAC	131.55	146	86	7.5	77.3

As a result, a Median Test as well as the Wilcoxon Matched Pairs Signed–Ranks Test (specified in paragraph 5.2, Changes in Statistical Methodology, listed at the beginning of the chapter) were run to characterize the population (Neter and others, 1985: 642; Wilcox, 1987: 338).

Wilcoxon Matched Pairs Signed–Ranks Test: where μ_1 is the NIPARS unit price from data set seven and μ_2 is the AF unit price (economically adjusted last price paid for non–standard items from data set seven).

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Rejection Region: $-1.96 \leq t \geq 1.96$

Results: $t = 2.78$ $\rho = .0054$

Conclusion: Fail to accept the Null Hypothesis; the two sample populations are different. In this case, the mean NIPARS unit price appears to be higher than the mean AFSAC economically adjusted last price paid.

Median Test: where μ_1 is the NIPARS unit price from data set seven and μ_2 is the AF unit price, economically adjusted last price paid for non–standard items from data set seven.

H_o: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Rejection Region: $-3.84 \leq X^2 \geq 3.84$

Results: $X^2 = .86 \quad \rho = .0018$

Conclusion: Fail to reject H_o. The two sample medians are not different.

5.4.1.2 Additional Characterization of the Pricing Data. Because of the mixed results from these tests, a Kolmogorov–Smirnov test was performed on the raw data to determine if there is a difference in their relative frequency distributions. The data was also standardized (by taking the differences between the matched NIPARS and AFSAC prices) then subsequently reexamined to determine if there was difference in the central tendency of the two sample populations.

Kolmogorov–Smirnov Test: Where $rf_{n_1 k}$ is the NIPARS unit price and $rf_{n_2 k}$ is the last price paid by AFSAC.

H_O: $rf_{n_1 k} \leq rf_{n_2 k}$

H_a: $rf_{n_1 k} > rf_{n_2 k}$

Test Statistic: Kolmogorov–Smirnov test

Rejection Region: $\chi^2 \geq \chi^2_{(2\,df, \alpha = .05)} = 5.99$

Results: $\chi^2_{(calc)} = 4.34 \quad \rho = .29$

Conclusion: Fail to reject H_o.The population of values from NIPARS was drawn form a lower population of values than the last price paid by AFSAC for the same items.

One Tailed t – Test: Analysis using the Wilk-Shapiro test showed that the population of differences between NIPARS and AFSAC unit prices was normally distributed (Wilk-Shapiro statistic = .998) when the population of differences was limited to those data points greater than –2000 and less than 2000. This limitation of the range of the data was deemed

appropriate because it resulted in the exclusion of only seven data points in a population of 336. Because the data met the requirements for analysis using parametric statistics, a One Tailed t-Test was conducted to determine if it included the value zero (0). If the distribution did not include zero then the test would confirm the Kolmogorov–Smirnov test.

Where $\mu 1$ is the matched difference between the NIPARS and AFSAC price data for each specific item in the population.

H_o: $\mu_1 = 0$

H_a: $\mu_1 \neq 0$

$\alpha = .05$

Rejection Region: $-1.96 \leq t \geq 1.96$

Results: $t = 1.965$ $\rho = .0242$

Conclusion: Fail to accept H_o. The area around the means of the two sample populations are different. Because a 95% confidence interval around the mean of the sample population does not include 0 (*5.05 to 65.39*) and the interval is composed of positive numbers (*AFSAC minus NIPARS*) it appears as though NIPARS has lower unit costs.

5.4.1.3 Correlational Study. The relationship between the two populations was explored using Spearman's Coefficient of Rank Correlation to determine the degree of association between the two samples. The following results were obtained:

Spearman's Rho	ρ value	95% Upper - Lower Confidence Intervals
.85	.0001	.82 — .88

The following Test of Hypothesis was used to determine if Rho was statistically significant:

H_o: $r = 0$

H_a: $r > 0$

$\alpha = .05$

Test Statistic: $t = \frac{r_s}{\sqrt{\frac{1-r_s^2}{n-2}}}$

Rejection Region: $-1.96 \leq t \geq 1.96$

Results: $t = 29.489$ $\rho = .001$

Conclusion: Fail to accept H_0. The two samples are monotonically related; they measure items in the same universe. Both samples measure prices of FMS items and inflation formulas are correctly applied.

5.4.2 Research Question 2.2. Is there a difference between the total costs for non-standard item support under NIPARS versus the total costs for AF procured non-standard items?

5.4.2.1 Characterization of the Data. When the data ($N = 336$) was examined for normality using the Wilk-Shapiro test it was found to exhibit no traits of normality. This analysis was confirmed with the high degree of kurtosis and skewness of the data shown below:

Data	Mean (dollars)	σ_s (dollars)	Median (dollars)	Skewness	Kurtosis
NIPARS	3650	7917	1207	5.89	49.04
AFSAC	7948	26917	1783.31	7.5	77.3

As a result, a Median Test was run to characterize the relationship between the populations under analysis.

Where μ_1 is the NIPARS computed total price from data set seven and μ_2 is the AF computed total price, economically adjusted last price paid plus administrative surcharges, for non-standard items from data set seven in the quantities which were ordered.

H_0: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

$\alpha = .05$

Rejection Region: $-3.84 \leq X^2 \geq 3.84$

Results: $X^2 = 5.04 \quad \rho = .0248$

Conclusion: Fail to accept the Null Hypothesis; the median values of the two sample populations are different and NIPARS is significantly lower at the 95% confidence level.

5.4.2.2 Correlational Study. The relationship between the two populations was explored using Spearman's Coefficient of Rank Correlation to determine the degree of association between the two samples. The following results were obtained:

Spearman's Rho	ρ value	95% Upper - Lower Confidence Intervals
.46	.0001	.54 — .371

The following Test of Hypothesis was used to determine if Rho was statistically significant:

H_o: $r = 0$

H_a: $r > 0$

$\alpha = .05$

Test Statistic: $t = \dfrac{r_s}{\sqrt{\dfrac{1 - r_s^2}{n - 2}}}$

Rejection Region: $-1.96 \leq t \geq 1.96$

Results: $t = 6.75 \qquad \rho = .001$

Conclusion: Fail to accept H_o. The two samples are monotonically related; they measure items in the same universe. Both samples measure prices of FMS items and inflation formulas are correctly applied.

5.5 *Results for Hypothesis Three.*

The FMS customer views the NIPARS process as adequately meeting their requirements for non-standard items.

5.5.1 Research Question 3.1. Is the service quality (SERVQUAL) testing instrument reliable and valid indicator of the sample populations expectations and perceptions of customer service?

5.5.1.1 Overview of Reliability and Validity. Because the SERVQUAL testing instrument exhibits reliability and validity, any results are likely to reflect the actual opinions of the customers of NIPARS. The metaphor most useful for decision makers is that the instrument represents a bright flashlight which can be used to illuminate the dark corners of an organization.

Kaplan and Saccuzzo report that classical test score theory assumes that each person has a true score that could be obtained if the measurement error in the instrument was known (Kaplan and Saccuzzo, 1989: 88). The assumption in this statement is that there is some degree of error, some variation from the true score, associated with the reported score from any test eliciting a respondent's expectations and perceptions. Therefore, it would be beneficial to analyze the SERVQUAL instrument to determine the extent to which it, varies from this true score, (reliability), and measures what it is supposed to measure (validity) in terms of the sample population before reporting any results.

5.5.1.2 Reliability Issues. "Attempting to define the validity of a test will be a futile effort if the test is not reliable" (Kaplan and Saccuzzo, 1989: 136). As a consequence the results from the questionnaire were initially analyzed using Cronbach's Alpha (α) to determine the extent to which the different items on the scale measure the same aspect of service quality (that the questions making up the factors in the questionnaire actually

measure expectations and perceptions connected with a particular factor). This purification process started with the examination of the items making up the individual factors, both expected and perceived, and concluded with the analysis of the factors as a whole. (Table 12). Carmines and Zeller as well as many others describe α as a conservative estimate of a measure's reliability. "Thus, the reliability of the (factor under analysis) can never be lower than the computed alpha" (Carmines and Zeller, 1982: 45). It also provides some idea of the error associated with a test.

Subsequently, this measure of reliability can also be used to compute the standard error of the measurement, S_m , which can be used to describe the sample more accurately than the sample standard deviation. Where S is the standard deviation of the scores; R is the computed α; and $S_m = S\sqrt{1-R}$, a 95% confidence interval can be computed with a Z value of 1.96 with the bounds of the interval formed by $\overline{X} \pm 1.96(S_m)$ for psychometric tests. (Kaplan and Saccuzzo, 1989: 110) Therefore, while the true score is not known, the formula allows the reader to be 95% confident that the true score falls within the computed interval. However, while no definitive answer can be given to the question: What about the other 5% of the 95% confidence interval?, some assumptions can be made regarding the error associated with the interval. First, because the SERVQUAL instrument has been well researched, its internal error can be assumed to be small. As a result, the majority of error can be attributed to either the sample size (N = 41 returned questionnaires, 41% return rate) or to some other unknown factor(s).

While α can be used to determine the reliability of the items making up a factor, it cannot be used determine the reliability of a score which is the result of the subtraction of two factors (expectations and perceptions). Kaplan and Saccuzzo mention the use of the following formula when determining the reliability (R) of a difference score for any two

TABLE 12.

SUMMARY OF CRONBACH ALPHA PURIFICATION

	Final α values Expectations	Final α values Perceptions
Tangibles	.81	.90
Reliability	.91	.91
Responsiveness	.83	.77
Competency	.90	.90
Empathy	.76	.79
Overall	.85	.89
The factor 'Tangibles' was removed from the overall scale because it's elimination increased the overall empathy α from .72 to .85 and the overall perception α from .84 to .89. This removal will be discussed in Chapter VI.		
Correlation between Expectations and Perceptions $(R_{12}) = .13$		
Deleted Questions as the Result of Purifying the Instrument with α.	E1, E10, E14, E19 P4, P5, P11, P14, P17,P22	

items when the reliability and the correlation between the two items are known (Kaplan and Saccuzzo, 1989: 105). In the following equation, R, the measure of reliability of the differences between the scores, can be found where r_{11} is the reliability of the expectation category, r_{22} is the reliability of the perception category, and r_{12} is the correlation between the two measures in the following equations:

$$R = \frac{\frac{1}{2}(r_{11} + r_{22}) - r_{12}}{1 - r_{12}}$$

The computed reliability factors for the two items can also be used to correct for the effect of the measurement error on the correlation measure (r_{12}) necessary to compute the reliability (R) of the final measure of the SERVQUAL instrument. This attenuation can be compensated through the use $\hat{r}$. Where $\hat{r}$ is the estimated true correlation $(\hat{r}_{12})$ between the categories of expectation and perception:

$$\hat{r} = \frac{r_{12}}{\sqrt{r_{11}r_{22}}} = \frac{.13}{\sqrt{(.85)(.89)}} = .149$$

Therefore, substituting the values for $\hat{r}$, r_{11}, and r_{22} and into the equation below:

$$R = \frac{\frac{1}{2}(.85+.89)-.149}{1-.149} = .85$$

Because .80 is normally considered the minimum score (R) necessary to declare a test reliable, the total SERVQUAL score can be considered reliable (Kaplan and Saccuzzo, 1989: 132).

5.5.1.3 Validity Issues. As previously stated in Chapter 3, the SERVQUAL instrument has face validity because the items are reasonably related to the perceived purpose of each particular scale and hence the general assessment of service quality. Another measure of validity, predictive validity, is also addressed because Parasuraman et al. state that customers consider reliability as the most important measure and responsiveness as the second most important measure when evaluating service quality. This is consistent with the results obtained from SERVQUAL instrument which indicates 69% of the respondents felt reliability was the most important of the five SERVQUAL measures. Additionally, Parasuraman states that these two measures are highly correlated. This assertion was confirmed in the sample population $(\alpha = .05)$.

When the instrument was evaluated in terms of the relationship between expectations and perceptions expressed by the sample population, a validity coefficient can be computed to determine the extent to which the test is valid for evaluating perceptions of service quality against expectations of service quality. This measure is expressed in terms of R_{12max}, the maximum validity of the test, where $R_{12max} = \sqrt{R_{11}R_{22}}$ (Kaplan and Saccuzzo, 1989: 136). When the appropriate values are substituted in from Table 12, $R_{12max} = \sqrt{(.85)(.89)} = .87$. Finally, the instrument exhibits convergent validity. "It

correlates well with other tests (which) measure the same construct." (Kaplan and Saccuzzo, 1989: 133) This was confirmed through a test of hypothesis of the significance of r (calculated value = .58 with 95% confidence limits of .297 to .74 using Fisher's Z transform) between Question 27 (Does NIPARS provide excellent service?) and the overall SERVQUAL score:

H_o: $\rho = 0$

H_a: $\rho \neq 0$

$\alpha = .05$

Rejection Region: $-2.021 \leq t \geq 2.021$

Results: $t_{(calc)} = 4.134$ $\rho = .3$

Conclusion: Fail to accept the null hypothesis; there is sufficient evidence to conclude that the instrument exhibits convergent validity.

5.5.2 Research Questions 3.2 and 3.3. Research questions 3.2 and 3.3 ask the questions: Do customers perceptions of service exceed their expectations of service? and Do customers view the contractual measures of performance as adequately measuring the quality of service they receive? The following tables support the discussion of these questions by reporting the results obtained from the analysis of the questionnaire. Table 13 reports simple statistics and the measures of reliability and validity of the expectations and perceptions of the five SERVQUAL factors. Table 14 reports these same items for the quality score where quality = expectations - perceptions. When reading the tables with quality scores, the reader should take into consideration that a negative score is a good score: perceptions of service have exceeded expectations of service. The third table, Table 15, reports the overall quality score computed from the SERVQUAL instrument. The next table (Table 16) reports the correlation coefficients between the unweighted SERVQUAL factors. Table 17 and 18 provide these statistics for the fully weighted responses from the sample population. As a result, these two tables take into consideration the relative importance the respondents assigned to each item and present a more complete picture of

the respondents evaluation other customer service delivered by NIPARS. Table 19 indicates the correlations associated between the weighted factors. Table 20 specifies the relative importance the respondents assigned to the five SERVQUAL factors. Finally, Table 21 provides information on questions 23, 24, 25, and 26 and Table 22 provides specific information on the respondents views on the two firm measures used to evaluate the prime NIPARS contractor.

TABLE 13.

SIMPLE STATISTICS AND MEASURES OF RELIABILITY
OF SERVQUAL INTERNAL ITEMS

	Expectation Score			Perception Score		
Category	Mean	σ_s	Reliability	Mean	σ_s	Reliability
Tangibles	5.23	1.22	0.87	5.5	1.50	0.89
Reliability	6.72	0.59	0.89	5.08	1.20	0.90
Responsiveness	6.20	1.04	0.71	5.29	1.26	0.77
Competence	6.17	0.94	0.87	5.22	1.26	0.77
Empathy	5.74	1.00	0.89	3.68	0.82	0.63

TABLE 14.

SIMPLE STATISTICS AND MEASURES OF RELIABILITY AND VALIDITY
OF UNWEIGHTED SERVQUAL FACTORS

Quality Factors	Mean	S.D.	95% Lower Limit	95% Upper Limit	Relia-bility	Validity Coefficient
Tangibles	-0.30	1.45	-1.32	0.72	0.86	0.88
Reliability	1.42	1.18	0.44	2.40	0.82	0.89
Responsiveness	0.89	1.63	-0.6	2.54	0.71	0.74
Competence	0.95	1.32	-0.58	2.48	0.66	0.81
Empathy	2.06	1.25	0.82	3.30	0.69	0.75

TABLE 15.

SIMPLE STATISTICS AND MEASURES OF RELIABILITY AND VALIDITY OF OVERALL UNWEIGHTED SERVQUAL FACTOR.

Total Quality Score (unweighted)	Mean	S.D.	95% Lower Limit	95% Upper Limit	Relia-bilty	Validity Coefficient
SERVQUAL	0.89	1.23	-0.03	1.89	0.85	0.87

TABLE 16.

CORRELATION COEFFICIENTS BETWEEN SERVQUAL FACTORS (α =.05).

Category	Tangibles	Reliability	Respon-siveness	Competence	Empathy
Tangibles	1.00				
Reliability	0.32	1.00			
Responsiveness	not significant	0.64	1.00		
Competence	0.32	0.54	0.32	1.00	
Empathy	not significant	0.48	0.64	0.41	1.00

TABLE 17.

SIMPLE STATISTICS OF WEIGHTED SERVQUAL FACTORS.

Weighted Quality Factors	Mean	S.D.	95% Lower Limit	95% Upper Limit
Tangibles	-0.01	0.19	-0.56	0.54
Reliability	0.09	0.49	-1.06	1.24
Responsiveness	0.28	0.38	-0.42	0.97
Competence	1.34	1.14	-0.20	2.89
Empathy	-0.25	0.24	-0.70	-0.21

TABLE 18.

SIMPLE STATISTICS OF WEIGHTED OVERALL SERVQUAL FACTOR.

Total Quality Score (weighted)	Mean	S.D.	95% Lower Limit	95% Upper Limit
SERVQUAL	0.29	0.30	0.17	0.41

TABLE 19.

CORRELATION COEFFICIENTS BETWEEN WEIGHTED SERVQUAL FACTORS (α =.05).

Category	Tangibles	Reliability	Respon-siveness	Competence	Empathy
Tangibles	1				
Reliability	not significant	1			
Responsiveness	not significant	.46	1		
Competence	not significant	not significant	not significant		
Empathy	not significant	not significant	not significant	not significant	1

TABLE 20.

IMPORTANCE OF FACTORS

Factor	Most Important (%)	2d Most Important (%)	Least Important (%)	Mean	σ_s
Tangibles	3	3	68	8.40	8.70
Reliability	62	29	0	29.0	13.0
Responsiveness	10	24	6	16.0	8.50
Competence	5	16	6	14.0	7.60
Empathy	3	3	12	9.60	5.30
Price	17	25	8	22.0	13.0

TABLE 21.

SIMPLE STATISTICS FOR QUESTIONS 23 THROUGH 26.

	Expectation Score		Perception Score		Quality Score	
Category	Mean	σ_s	Mean	σ_s	Mean	σ_s
Question 23	6.53	0.81	5.00	1.50	1.50	1.50
Question 24	5.31	1.77	5.46	1.59	-1.44	2.19
Question 25	5.78	1.46	5.50	1.60	0.32	1.15
Question 26	5.85	1.38	5.29	1.44	0.29	1.10

TABLE 22.

SIMPLE STATISTICS AND MEASURES OF RELIABILITY AND VALIDITY FOR EXPECTATIONS AND PERCEPTIONS OF CONTRACT PERFORMANCE MEASURES.

Evaluations of Contract Performance Measures	Mean	S.D.	95% Lower Limit	95% Upper Limit	Reliability	Validity Coefficient
Expectations of Measures	5.68	1.21	3.82	7.00	.64	.83
Perceptions of Measures	5.68	1.34	3.10	7.00	.72	.84
Total Evaluation of Contractual Measures of Performance	.3	.96	-1.712	2.31	.15	.64

NOTE 1: There is a statistically significant (α = .05) correlation $(r_{12} = .38, \hat{r}_{12} = 1)$ between the total score and Question 27 which evaluates overall perceptions of the quality of service provided by NIPARS. This correlation supports the contention that the measure is valid.

NOTE 2: There is a statistically significant correlation, α = .05, of the total score to the unweighted total SERVQUAL score $(r_{12} = .29, \hat{r}_{12} = .35)$ as well as with the weighted SERVQUAL score $(r_{12} = .21, \hat{r}_{12} = .25)$ when α = .05.

VI. Discussion and Conclusions

6.1 Overview

This chapter discusses the statistical data presented in the previous chapter. It begins with an executive summary and then examines each hypothesis and research question individually. It also presents suggestions for further study.

6.2 The Bottom Line

6.2.1 Hypothesis One. A significant difference does exist in the measures of performance for non-standard items under NIPARS versus the previous methods used to provide this support. NIPARS provides significantly faster PALT and PLT (for non-standard as well as standard FMS items) to its customers when compared to previous methods used to provide this support. However, NIPARS does not have a lower average time to cancel requisitions than do the majority of ALCs.

6.2.2 Hypothesis Two. Using economically adjusted data, a significant difference exists in the costs of non-standard items requisitioned through NIPARS versus the previous methods used to provide this support. While the majority of NIPARS unit prices were lower than ALC unit prices, the total price for NIPARS procured items were significantly lower than ALC procured items.

6.2.3 Hypothesis Three. The FMS customer views the NIPARS process as adequately meeting their requirements for non-standard items. In general, NIPARS appears to be rendering satisfactory customer service. However, the customer may not be able to accurately predict prices for goods and services based on previous methods used to provide this support (see Investigative Question 2.2 $\left[r_{12}^2 = .21\right]$). It also appears NIPARS

needs to concentrate on how customers can save money. Thirdly, it appears they need to better advertise their successes. As a result, NIPARS appears to require management attention to refine the manner in which it communicates to its customers. Finally, cancellation rate and PALT do not appear to be accurate predictors of the level of customer service that the customer perceives he/she receives.

6.2.4 Summary. NIPARS appears to be providing faster and less expensive service than the previous methods used to supply FMS customers with non-standard items. However, NIPARS appears to have an image problem with its customers.

6.3 Hypothesis One

6.3.1 Investigative Question 1.1. There is a significant difference between average times to cancel requisitions at the ALCs. Three ALC groupings were identified using the large sample analog of the Bonferroni test. The first grouping was formed from Ogden, Oklahoma City, and Warner-Robins ALCs while Sacramento and San Antonio ALCs formed separate groupings. Using a test of medians, the grouping of Ogden, Oklahoma City, and Warner-Robins ALCs, when compared to NIPARS, demonstrated a significantly higher average time to cancel than NIPARS. However, Sacramento and San Antonio ALCs demonstrated significantly lower average times to cancel than NIPARS. Because there was a significant difference between median and mean values between the sample populations, a Kolmogorov-Smirnov test was used to examine whether the respective samples came from populations of lower or higher values rather than just comparing the measures of central tendency between the samples. The results showed that only San Antonio's time to cancel came from a population of higher values than NIPARS. The reader must consider that these higher values may be the result of San Antonio's position as the primary supplier for proven aircraft which may expose them to a higher percentage of difficult to identify items. However, this study did not address this question.

6.3.2 Investigative Question 1.2. Two sample populations (on contract and shipped status) were available to evaluate PALT for the ALCs. When the data was explored to determine the differences between the two data samples, the analysis showed that, while the two samples came from the same universe, their relative frequency distributions were different. As a result, NIPARS was compared to each sample separately. In the first sample (taken from items placed on contract) differences between ALCs forced the following groupings. Oklahoma City and Ogden were formed into one grouping; San Antonio and Warner-Robins were formed into another while Sacramento was grouped by itself. A median test demonstrated each of these groups had significantly different average PALTs, but none was lower than NIPARS. The second sample of ALC data included those items that were shipped during the period of interest. A Kruskal Wallis test yielded different groupings from those found in the first sample. In this sample, Oklahoma City and Ogden ALCs formed one group, while each of the other three ALCs formed their own individual groupings. Again, a median test showed that each of the groupings had significantly different average PALTs, but none was lower than NIPARS. From this we can conclude that NIPARS takes significantly less time to place non-standard items on contract than the ALCs.

6.3.3 Investigative Question 1.3. Analysis using a Kruskal Wallis test of the sample population for ALC PLT led to the following groupings. Oklahoma City and Ogden ALCs formed one grouping while each of the other three ALCs formed their own individual groups. A median test showed that each of these groupings had significantly different average PLTs, but none were lower than NIPARS. From this we can conclude that NIPARS takes significantly less time than the ALCs to supply non-standard items when measured from contract award to shipment.

6.3.4 Investigative Question 1.4. Two sample populations (on contract and shipped status) were available to evaluate PALT for the ALCs. Analysis of the data, to

determine the differences between the two data samples, showed that while the two samples came from the same universe, their relative frequency distributions were different. As a result, NIPARS was compared to each sample separately. In the first sample (taken from items placed on contract) differences between ALCs forced the following groupings. Oklahoma City, Ogden, and Warner–Robins ALCs formed into one group; San Antonio ALC into a second group; and Sacramento ALC formed a third group. A median test demonstrated each of these groups had significantly different average PALTs, but none was lower than NIPARS. The second sample of ALC data was formed from those items that shipped during the period of interest. A Kruskal Wallis test yielded different groupings from the first sample. In this sample, San Antonio and Ogden ALCs formed one group, Oklahoma City and Warner–Robins ALCs formed a second group, and Sacramento ALC formed its own individual group. Again, a median test showed that each of the groupings had significantly different average PALTs, but none was lower than NIPARS. From this we can conclude that NIPARS takes significantly less time to place non–standard items on contract when compared to the amount of time the ALCs take to place standard FMS items on contract.

6.3.5 Investigative Question 1.5. Analysis using a Kruskal Wallis test of the sample population for ALC PLT led to the following groupings. Oklahoma City and Ogden ALCs formed one grouping while each of the other three ALCs formed their own individual groups. A median test showed that each of the groupings had significantly different average PLTs, but none were lower than NIPARS. From this we can conclude that NIPARS takes significantly less time to provide non–standard items than the ALCs take to supply standard items when measured from contract award to shipment. The reader should note that the ALC statistics do not include those items shipped from stock. However, unless the country participates in a Cooperative Logistics Supply Support arrangement with the USG, support is normally lead time away.

6.4 Hypothesis Two

6.4.1 Investigative Question 2.1. Since the unit cost samples for AFSAC and NIPARS exhibited extreme kurtosis, a median test was performed, along with a Wilcoxon Matched Pairs Signed–Ranks test, to examine the relationship between the two samples more closely than just with the Wilcoxon Matched Pairs Signed–Ranks test. However, these two tests gave conflicting results. The median test showed that the populations had different medians, while the Wilcoxon Matched Pairs Signed–Ranks test showed that, when matched data points (NSNs) were used as the basis for comparison, NIPARS average unit price appeared to be higher. As a result, further analysis of the data using the Kolmogorov–Smirnov test was used to compare the relative frequency distributions of the two samples. The results of this test showed NIPARS unit prices were drawn from a population of lower values than AFSAC unit prices. To further highlight the differences between the two samples, the data was standardized by subtracting the two samples (*AFSAC minus NIPARS*). Analysis of the standardized data showed that, except for some outliers, it was normally distributed. As a result, a One Tailed t–Test was conducted to determine if the standardized distribution included the value 0 in a 95% confidence interval around the mean. Since the result of the t–Test showed the distribution did not include 0 and had a 95% confidence interval around the mean from 5.05 to 65.39, the researchers reached the conclusion that the majority of NIPARS unit prices are lower than the AFSAC unit price. Therefore, if unit prices can be considered a true representation of material cost, this analysis indicates NIPARS generally provides non–standard items at a lower cost in terms of material value. The correlational study produced an r of .85 meaning the two samples belong to the same universe of data meaning that both samples measure the same type of thing. The r^2 value of .725 indicates that NIPARS prices are consistent with previously charged prices for the same items.

6.4.2 Investigative Question 2.2. Since the total cost data exhibited the same extreme kurtosis as unit cost data, the same tests used in Investigative Question 2.1 were used in Investigative Question 2.2 . Unlike the tests performed for Investigative Question 2.1, both the median and Wilcoxon tests showed that the sample populations were different in location of both their medians and means. Since the mean and median values from NIPARS are lower than those for AFSAC, the research makes the conclusion that NIPARS total costs (including economically adjusted unit price, award, and processing fees) are lower than AFSAC total costs (including economically adjusted unit price and standard FMS surcharges). However, individual customers may experience different degrees of savings based on their ordering practices. This was confirmed through a correlational study which showed an r^2 value of .2116. This value demonstrated that, although the majority of NIPARS prices are lower, the customer has little ability to adequately predict prices of the goods and services he receives based on his experiences with previous methods used to provide this support.

6.5 Hypothesis Three

6.5.1 Investigative Question 3.1. The overall reliability of the instrument, (R =.85) implies that the instrument explains about 85% of the respondents' views on service quality that can be attributed to the SERVQUAL instrument and 15% can be attributed to random error. However, there is some evidence that indicates the remaining 15% may not be attributable to random error in the testing instrument but to the respondents view of the firm measures of contract performance since the overall reliability of this measurement (R) is .15. This conjecture is supported by the statistical correlation (α =.05) between the respondents' evaluation of the contractual measures of performance and Question 27 ($\hat{r}_{12}$ = 1), the unweighted total SERVQUAL score ($\hat{r}_{12}$ =.35), as well as the weighted total SERVQUAL score ($\hat{r}_{12}$ =.25). Indicating the measure exhibits

convergent validity. Although correlation does not imply cause and effect, there appears to be intuitive evidence to support the contention that the contractual measures of performance account for 15% of the customers' perceptions of the service they receive.

The overall reliability of the instrument was enhanced through the removal of the factor "tangibles" from the computation of the SERVQUAL score. This greatly reduced the error associated with the instrument, and may mean that the respondents' evaluations of the items that make up this area do not integrate with the overall intent of the instrument to evaluate the quality of service provided under the NIPARS program. It may also mean that the questions designed to elicit opinions about tangibles need refinement. Additionally, respondents had the lowest expectations of tangibles than any other factor under analysis meaning they give it little weight in evaluating the quality of service they receive. However, it appears that the perceptions of the respondents generally exceeded their expectations of the appearance of physical facilities and equipment. In any case, little explanatory power was lost with the deletion of this factor. The SERVQUAL instrument can be considered valid because it exhibits content, predictive, and convergent validity. The questions the instrument uses seem reasonable, the results from the survey confirm the relationships proposed by the developers of the SERVQUAL instrument, and correlate significantly (α =.05) with an overall measure of customer service. As a result, the instrument represents a bright flashlight that can be used to illuminate the dark corners of an organizations interface with its customers. With further work, the SERVQUAL instrument could be readily adapted for use in determining the quality of service rendered by agencies within the DOD as well as contractors providing services to the DOD community.

6.5.2 Investigative Question 3.2. When the respondents' scores for expectations and perceptions are plotted on a scale, three categories of respondents were identified (Figure 9). The first category, representing 63% of the respondents, is characterized by both high expectations as well as high perceptions of the service provided by NIPARS. The second category (20% of the respondents) represents those individuals that have high to moderate expectations and moderate perceptions of performance. The third category characterizes the remaining 17% of the respondents. It exhibits moderate to low expectations of performance but has very low perceptions of the quality of service by NIPARS.

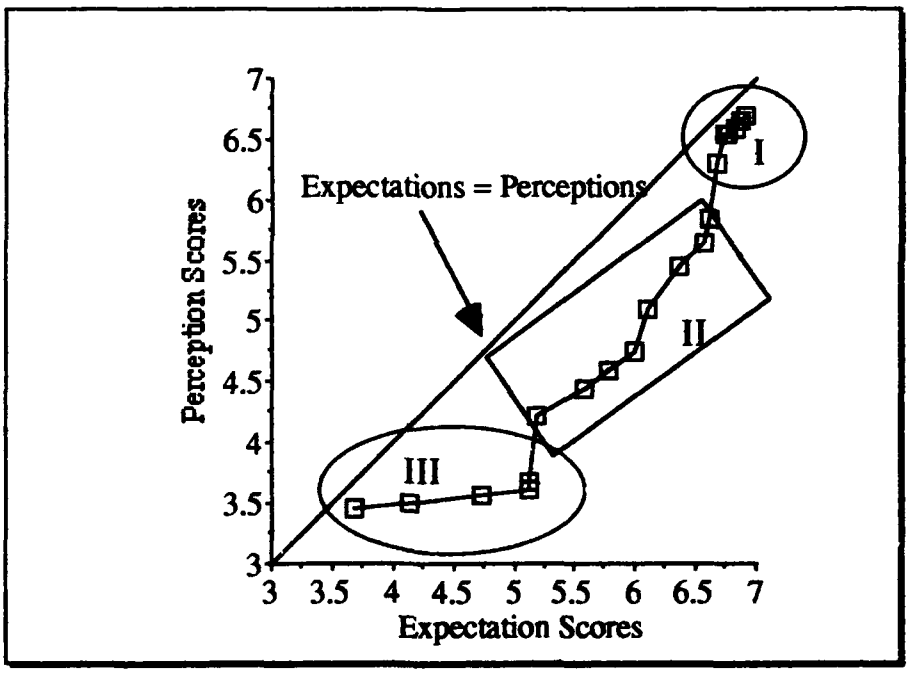


Figure 9. Categories of Respondents.

A Wilk-Shapiro statistic, greater than .972 for each of the individual SERVQUAL factor scores (as well as the overall SERVQUAL score), indicates they were normally distributed. As a result, parametric statistics were used to analyze the data from the questionnaire. Because the overall weighted and unweighted SERVQUAL mean scores are positive,

perceptions do not meet expectations. The weighted SERVQUAL score ([EXPECTATIONS - PERCEPTIONS] * WEIGHT) has a mean of .29 with a lower confidence interval of .17 and an upper confidence interval of .41 and a standard deviation of 3. This score is also less variable than the unweighted score. The researchers attribute its smaller variability to relative agreement on the importance of the weighting factors. Because all the weighted scores are less variable than the unweighted scores, it also appears the weighted scores are better overall measures of the respondents' evaluations of the quality of service (Kaplan and Sccuzzo, 1989: 90). As a result, since the weighted overall score's confidence level does not include zero, in general, expectations of service quality are higher than perceptions of service quality. Additionally, there is comparative low variability in the score, indicating relative agreement among the respondents on the rating. However, since the mean weighted score is less than the mean unweighted score, one can also conclude many of the respondents evaluate NIPARS as doing more of the important things right versus doing more of the less important things correctly. Moreover, these scores are significantly better than the typical scores listed by Parasuraman, Zeithaml, and Berry (1986) for commercial industries (Table 23). This means that NIPARS is providing better customer service than normally provided in the commercial business sector. Significantly, respondents' expectations of service are not significantly different from those reported from civilian industry meaning that the higher scores were the result of higher perceptions of the quality of service by the sample population.

Analysis of the individual factor scores of the NIPARS program and the commercial industries listed by Parasuraman et al (1986) yields some interesting insights. Specifically, while the scores for competence are the same as from the commercial sample population, the scores for empathy are much higher than the commercial sector. In fact, the

TABLE 23.

SERVQUAL SCORES FROM CIVILIAN INDUSTRIES
(Parasuraman and others, 1986: 24-25)

Industry	Mean	S.D.
Bank	0.88	0.98
Credit Card Company	0.93	1.01
Repair and Maintenance Company	1.11	1.18
Long-Distance Telephone Company	0.92	1.00
NIPARS	0.29	0.30

perceptions of empathy exceed the expectations of the sample population. Conversely, the respondent's evaluation of the reliability and responsiveness of NIPARS is significantly higher (worse) than of the surveyed commercial industries ($\alpha = .05$).

Looking at NIPARS' scores alone, the 95% confidence limits of the individual SERVQUAL factors do include zero as well as negative numbers meaning that there is the possibility that the true mean score would show that expectations are equal to, or less than, perceptions of service. Nonetheless, the mean value is recognized by the developers of the scale as the indicator of the organization's performance. As a result, there are three areas that should be addressed because of these scores. These areas are reliability, responsiveness, and competence. While reliability is indicated as a problem area which may require management attention, the fact that the mean value is close to 0 (.09) on a scale of -6 to +6 indicates that this area is not a large problem. This analysis also holds true for the mean score for responsiveness. Its mean value is also close to 0 (.29). Yet, there are some interesting correlations that exist between the scores for reliability and responsiveness and questions 23, 24, and 25 as well as the overall evaluation of the contractual measures of performance. Reliability and responsiveness are significantly correlated ($r_{12} = .46$). Reliability is positively correlated to the overall evaluation of the

contractual measures of performance when $\alpha = .05$, $(r_{12} = .33)$. It is also positively correlated $\alpha = .05$ to question E23 which elicits expectations of how well NIPARS keeps its customers informed about matters which relate to them. However, it is also negatively correlated when $\alpha = .05$ to question P23 (which elicits perceptions of how well NIPARS keeps its customers informed) as well as question 25 (which elicits perceptions on fill rate as a measure of performance). While they do not necessarily imply cause and effect, some inferences can be made from these correlations. These are that the respondents consider communication an important part of reliability; that overall, contractual measures of performance are also a measure of reliability; but, the perception is that fill rate is not as effective as PALT for evaluating reliability; and finally, that responsiveness is an important evaluation of the reliability of service. While responsiveness is positively correlated to reliability, it is also negatively correlated to Question P23 (NIPARS keeps you informed about matters that concern you.) as well as positively correlated to question Q24 (expectations/perceptions of whether NIPARS helps the customer learn how to keep costs down). These correlations also enable the researchers to make the inference that reliability and responsiveness are also tied to the ability of NIPARS to communicate effectively with its customers. The importance of communication is highlighted by the analysis presented in Investigative Question 2.2 which states that customers cannot accurately predict the total costs of NIPARS procured items based on their experiences with the previous methods used to provide non-standard item support.

While the mean values for reliability and responsiveness indicate minimal problems the mean value of competence is 1.34. This value, coupled with a relatively high standard deviation as compared to the other factors, means that this area could be responsible for the respondent's perceptions of service not exceeding their expectations of service for the overall measure SERVQUAL score. It is correlated to the respondent's expectations of the ability of NIPARS to keep its customers informed as well as expectations of NIPARS showing

customers how to keep costs down. Since the definition of competence involves the ability of NIPARS to convey trust and confidence in their actions it appears that a change in the manner in which communication is carried on between NIPARS and the customer is warranted to enhance customer perceptions' of customer service.

6.5.3 Investigative Question 3.3. The overall evaluation of the contractual measures of performance examines the difference between customers' expectations and perceptions regarding the efficacy of the measures of service quality found in the NIPARS contract (cancellation rate and PALT). The reliability score obtained from this measure indicates service quality cannot be defined in terms of conformance to specifications. This finding is congruent with the literature pertaining to service quality that states that the nature of customer service for goods and the nature of customer service for services differs. Although they both ideally start with the identification of customer's needs, goods are produced before they are sold and services are generally sold before they are produced. This distinction highlights the importance of communication between NIPARS and its customers. Nonetheless, while the mean value of the overall evaluation of the contractual measures of performance (.3) indicates that there is little area for concern, the wide 95% confidence interval around the mean indicates that there is very little agreement on the efficacy of these two measurements. This also supports the contention that service quality cannot be adequately defined in terms of conformance to a specification. These results highlight the need for AFSAC (as well as all government offices that contract for services) to carefully examine the measures of performance they write into a contract.

6.6 All in Perspective

As a result of the data presented in this thesis, this thesis concludes that NIPARS is rendering significantly improved support of non-standard items. However, the favorable analysis of the NIPARS program presented in this thesis may lead the reader to the

tempting conclusion that NIPARS is a panacea for all the ills of FMS support. While providing its FMS customers superior service, NIPARS was not intended nor designed to replace the total package approach to logistics required for system sales. It is not the "do all, cure all" for all FMS logistics problems. NIPARS was intended to provide "after–market" support of non–standard items and it does an excellent job at what it was designed to do.

6.7 Recommendations for Further Study

From the experiences of the research team during this study, a number of areas were identified for possible future research.

1. While this study focused on the support of non–standard items, future research could be directed at analyzing the repair services portion of the NIPARS contract. It could also examine the possibility of utilizing a NIPARS type contract to provide an extensive array of services to customer countries rather than depend on AF resources for this support.

2. There exists a need to perform an ABC analysis of the items being ordered to determine which items have the most variable PALT, PLT, etc..

3. Similarly, analysis of the reason why NIPARS is outperforming USAF procurement of standard FMS items could prove fruitful.

4. Future research could involve administering the SERVQUAL instrument to personnel within the logistics system of the host customer country.

5. Future research on the refinement of the SERVQUAL instrument could result in the provision of a standard measure of customer service for the DOD.

6. Finally, future research needs to examine the relationship between contractual measures of performance and the expectations of the desired service and perceptions of the service actually delivered.

Appendix A: SERVQUAL Questionnaire

NIPARS CUSTOMER SERVICE SURVEY

Thank-you for your participation in this endeavor. It is designed to assess the quality of the customer service provided by the NIPARS system for the procurement of non–standard items. Your responses will be kept anonymous

Please take the time to fill out this questionnaire... We value your opinion!

Directions: Based on your experiences as a consumer of FMS services, please think about the kind of organization that would deliver excellent quality service. Think about the kind of organization with which you would be pleased to do business. Please show the extent to which you think these services should possess the features described by each statement. If you feel a feature is *not at all essential* for the satisfactory FMS provisioning of non-standard items circle the number 1. If you feel a feature is *absolutely essential* for the satisfactory FMS provisioning of non-standard items circle the number 7. If your feelings are less strong, circle one of the numbers in the middle. There are no right or wrong answers all we are interested in is a number that best shows your expectations about the services.

	Strongly Disagree						Strongly Agree
1. They should have up-to-date equipment.	1	2	3	4	5	6	7
2. Their physical facilities should be visually appealing.	1	2	3	4	5	6	7
3. Their employees should be neat appearing.	1	2	3	4	5	6	7
4. Materials associated with the service (such as reports or statements) will be visually appealing.	1	2	3	4	5	6	7
5. When NIPARS promises to do something by a certain time, they should do so.	1	2	3	4	5	6	7
6. When customers has a problem, NIPARS should show a sincere interest in solving it.	1	2	3	4	5	6	7
7. NIPARS should be dependable.	1	2	3	4	5	6	7
8. NIPARS should provide its services at the time they promise to do so.	1	2	3	4	5	6	7
9. NIPARS should keep their records accurately.	1	2	3	4	5	6	7
10. They shouldn't be expected to tell customers exactly when services will be performed.	1	2	3	4	5	6	7
11. It is not realistic for customers to expect prompt service from the staff of NIPARS.	1	2	3	4	5	6	7
12. The staff of NIPARS doesn't always have to be willing to help customers.	1	2	3	4	5	6	7
13. It is okay if NIPARS staff are too busy to respond to customer requests promptly.	1	2	3	4	5	6	7

(continued)

	Strongly Disagree						Strongly Agree
14. The behavior of NIPARS staff will instill trust and confidence in customers.	1	2	3	4	5	6	7
15. Customers of NIPARS will feel safe in their transactions.	1	2	3	4	5	6	7
16. The staff in the NIPARS program will be consistently courteous with customers.	1	2	3	4	5	6	7
17. The staff in NIPARS will have the knowledge to answer customers' questions.	1	2	3	4	5	6	7
18. NIPARS should not be expected to give customers individual attention.	1	2	3	4	5	6	7
19. NIPARS will have operating hours convenient to all their customers.	1	2	3	4	5	6	7
20. NIPARS will have a staff who gives customers personal attention.	1	2	3	4	5	6	7
21. It is unrealistic to expect NIPARS will have the customer's best interests at heart.	1	2	3	4	5	6	7
22. The staff of NIPARS will understand the specific needs of their customers.	1	2	3	4	5	6	7
23. NIPARS should keep customers informed about matters which concern them.	1	2	3	4	5	6	7
24. It is unrealistic to expect NIPARS to help customers learn how to keep costs down.	1	2	3	4	5	6	7
25. Customers should expect that fill rate is a good measure of the services they receive from NIPARS.	1	2	3	4	5	6	7
26..Customers should expect that administrative lead time is a good measure of the service they receive from NIPARS.	1	2	3	4	5	6	7

(continued)

Directions: Listed below are six features pertaining to FMS suppliers and the services they offer. We would like to know how important each of these features is to *you* when you evaluate their quality of service. Please allocate a total of 100 points among the five features according to how important each feature is to you — the more important a feature is to you, the more points you should allocate to it. Please ensure that the points you allocate to the five features add up to 100.

---

1. The appearance of the physical facilities, equipment, personnel, and communication materials. _____ points

2. The ability to perform the promised service dependably and accurately. _____ points

3. The willingness to help customers and provide prompt service. _____ points

4. The knowledge and courtesy of the employees and their ability to convey trust and confidence. _____ points

5. The caring, individualized attention provided to customers. _____ points

6. The price of the goods or services. _____ points

TOTAL points allocated ***100 points***

Which *one* feature among the six above is *most important* to you? (please enter the feature's number) ✗_____

Which feature is *second* most important to you? ✗_____

Which feature is *least* important to you? ✗_____

(continued)

Directions: The following set of statements relates to your feelings about NIPARS. For each statement, please show the extent to which you believe NIPARS has the feature described by the statement. Once again, circling a 7 means that you strongly agree that NIPARS has that feature, and circling a 1 means that you strongly disagree. You may circle any of the numbers in the middle that show how strong your feelings are. There are no right or wrong answers all we are interested in is a number that best shows your perceptions about the NIPARS program.

	Strongly Disagree						Strongly Agree
1. They have have up-to-date equipment.	1	2	3	4	5	6	7
2. Their physical facilities are visually appealing.	1	2	3	4	5	6	7
3. Their employees are well dressed and appear neat.	1	2	3	4	5	6	7
4. The appearance of the physical facilities of NIPARS is in keeping with the type of services provided.	1	2	3	4	5	6	7
5. When NIPARS promises to do something by a certain time, it does so.	1	2	3	4	5	6	7
6. When you have problems, NIPARS shows a sincere interest in solving it.	1	2	3	4	5	6	7
7. NIPARS performs the service right the first time.	1	2	3	4	5	6	7
8. NIPARS provides its services at the time it promises to do so.	1	2	3	4	5	6	7
9. NIPARS keeps its records accurately.	1	2	3	4	5	6	7
10. NIPARS does not tell customers exactly when services will be performed.	1	2	3	4	5	6	7
11. You do not receive prompt service from the staff at NIPARS	1	2	3	4	5	6	7
12. The staff at NIPARS is not always willing to help customers.	1	2	3	4	5	6	7
13. The staff at NIPARS is too busy to respond to your requests promptly.	1	2	3	4	5	6	7

(continued)

	Strongly Disagree						Strongly Agree
14. The behavior of the employees in NIPARS instills trust and confidence in you.	1	2	3	4	5	6	7
15. You feel safe in your transactions with NIPARS.	1	2	3	4	5	6	7
16. The NIPARS staff is consistently courteous to you.	1	2	3	4	5	6	7
17. The NIPARS staff has the knowledge to answer your questions	1	2	3	4	5	6	7
18. The personnel in the NIAPRS program do not give you individual attention.	1	2	3	4	5	6	7
19. NIPARS has operating hours convenient to all its customers.	1	2	3	4	5	6	7
20. NIPARS program personnel give you personal attention.	1	2	3	4	5	6	7
21. The NIPARS program does not have your best interests at heart.	1	2	3	4	5	6	7
22. Employees of NIPARS understand your specific needs.	1	2	3	4	5	6	7
23. NIPARS keeps you informed about matters which concern you.	1	2	3	4	5	6	7
24. NIPARS does not help you learn how to keep costs down	1	2	3	4	5	6	7
25. For you, fill rate is a good measure of the service you receive from NIPARS.	1	2	3	4	5	6	7
26. For you, administrative lead time is a good measure of the services you receive from NIPARS.	1	2	3	4	5	6	7
27. NIPARS does an excellent job of satisfying my needs for non–standard parts.	1	2	3	4	5	6	7

(End... Thank–you for your time)

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Vitae

Captain Peter F. de KAM was born on 11 February 1957 in Detroit, Michigan, and subsequently graduated from Franklin Regional High School, Murrysville, Pennsylvania in 1975. After attending The Pennsylvania State University for two years he enlisted in the Air Force as a Dental Laboratory Specialist. In 1982, he graduated from the University of the Philippines with an undergraduate degree in political science with a minor in Asian History. He subsequently attended the Graduate school for Political Science at the University of the Philippines. While there he did basic research in developing an Asian Model of Political Psychology. He graduated from Chapman College with a M.S. in Human Resource Management with a concentration in Organizational Development in 1984. Immediately after graduation he cross trained as a Ground Forward Air Controller with a subsequent assignment to the 9th Infantry Division (Motorized) and the 2d Ranger Battalion 75th Infantry Regiment at Fort Lewis, WA. He was commissioned through Officer Training School 13 May 1987 and served as a Deputy Missile Combat Crew Commander, Instructor/Evaluator Deputy Missile Combat Crew Commander, Chief, Operations Readiness Branch, Command Post Controller, and Missile Combat Crew Commander with the Ground Launched Cruise Missile System at Florennes AB, Belgium and at Comiso AS, Sicily. After completion of AFIT he will be assigned to the Defense Meterological Satellite Program, Space Systems Center, Los Angeles AFB, California. He was selected as a member of Sigma Iota Epsilon for academic excellence in the field of Management Science.

Permanent Address: 627 Lake Shore Drive
Maitland, Florida 32751

Captain Dorothy J. Tribble was born on 5 March 1953 in Cleveland, Mississippi, and subsequently graduated from Cleveland High School in 1971. In January 1980, she enlisted in the Air Force and served as an Aircraft Maintenance Instructor at Sheppard AFB, Texas. In 1984, she earned a Bachelor of Science in Occupational Education from Wayland Baptist University, and was commissioned through Officer Training School in 1985. After completing Aircraft Maintenance Officer Training at Chanute AFB, Illinois, she was assigned to the International Logistics Division at Kelly AFB, Texas. Prior to attending AFIT, she was assigned to the 513th Aircraft Generation Squadron at RAF Mildenhall, United Kingdom, from April 1988 to April 1991. While at RAF Mildenhall, she served as the OIC of the 306th Aircraft Maintenance Unit and the Assistant Maintenance Supervisor. After graduating from AFIT she will be assigned to the 58th Component Repair Squadron at Luke AFB, Arizona.

Permanent Address: 7270 Charnwood Drive
Huber Heights OH 45424

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Historically, Foreign Military Sales non-standard item support has been a labor-intensive, time-consuming process. Additionally, when forced to compete for USAF resources, the foreign customer's need is often subjugated to the higher priority active USAF requirements. These problems motivated the Air Force to initiate a program to streamline procedures for the procurement of non-standard items. The program is the Nonstandard Item Parts Acquisition and Repair Support (NIPARS) program. The basic program concept is to move the management tasks for non-standard items from USAF resources to a contractor in order to "fix" the inefficiencies of the previous system. This thesis explores the efficacy of this program by comparing the procurement administrative lead time, production lead time, cancellation rates, and costs of the NIPARS program to those of the Air Logistics Centers. Additionally, the expectations and perceptions of the NIPARS customer is evaluated to determine whether or not NIPARS represents an improvement in the quality of customer service the Air Force is providing to its foreign customer.

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